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SO BIG?

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MAKE YOUR
BREATH STINK?

Why are
BALD HEADS
SO Shiny?

WHY DO
SWEATY FEET
SMELL
OF **CHEESE?**

IF YOU **HOLD IN A**
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**IMMEDIATE
MEDIA** CO



Hello!

Life is full of questions. Why do cats hate water? Can VR trick your brain? Could an asteroid smash Earth out of its orbit? Why do sweaty feet smell of cheese? Wonder no more, because we are here to feed your curiosity. Our **giant 25-page Q&A section** (p64) answers all your mind-blowing questions about the human body, animals, space, dinosaurs, food, and much more.

If you're hungry for more stuff, then don't miss our bigger investigations, like what will happen when a spacecraft plunges into the Sun (p24), and what the tiny bugs in our bodies really do (p56). You can also discover if we could let wolves loose in the UK (p49), or what we'll see when we scour the depths of Loch Ness (p16), and find out why plastic isn't fantastic (p32).

If you fancy something more hands-on, then we've got some awesome experiments you can do in the kitchen. Best of all, you can scoff them when you're done (p40)! We're partial to some unicorn noodles ourselves...

And that's not all, be amazed by a scientist who explores creepy caves (p92), make some magic with the new Harry Potter wand (p30) and snuggle down to find out more about hibernation (p62).

We'd love to hear what you think about this special kids' issue of *BBC Focus*, so drop us an email to reply@sciencefocus.com
Stay curious!

Alice Lipscombe-Southwell, Editor



MARVELLOUS MINI POSTERS TO CUT OUT AND KEEP



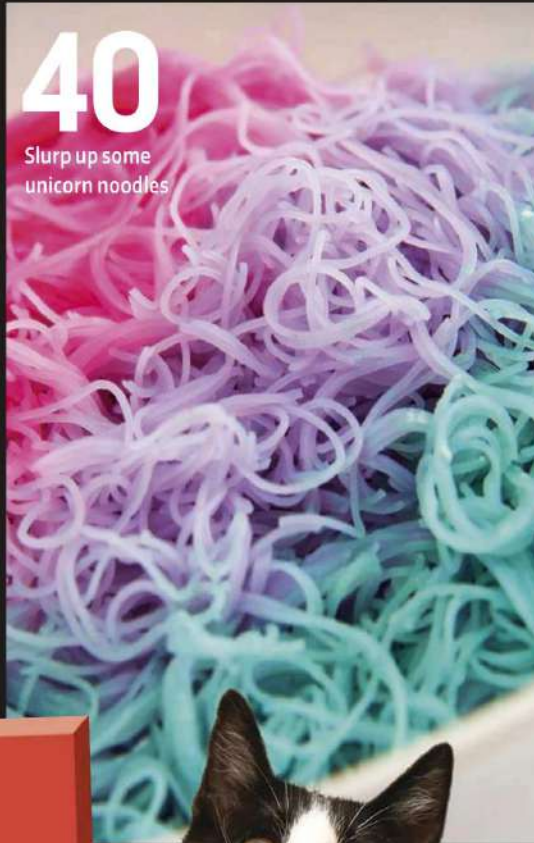
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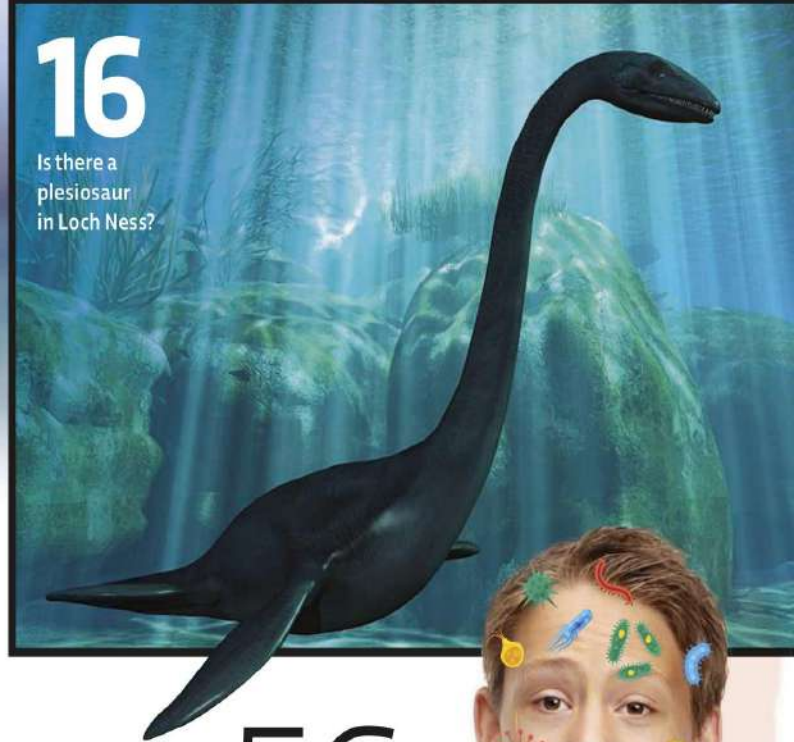


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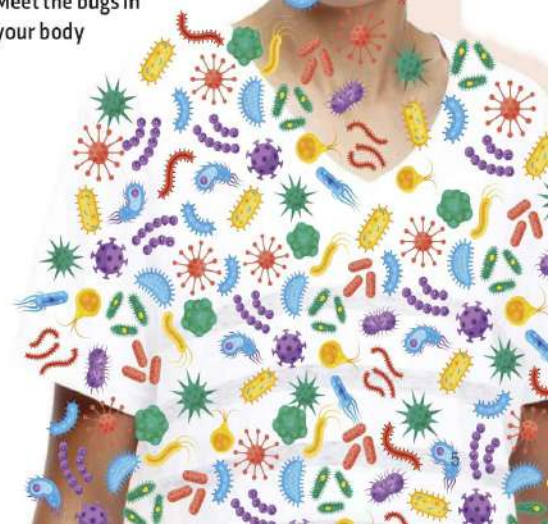


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Dive, dive, dive!

You won't find this suit for sale in the shops! Dubbed the Exosuit, this 'atmospheric diving suit' was made by Canadian undersea technology specialists Nuytco Research Ltd. It is made from tough aluminium and is used for building work at marine oilfields around the world. However, it has also been used to explore a 2,000-year-old shipwreck on the Greek island of Antikythera. Using the suit, divers can descend to a depth of 300m, and it has enough oxygen to keep them breathing for up to 50 hours – though dives typically don't last more than a few hours.

PHOTO: NATIONAL GEOGRAPHIC







THE BEAT

THIS YEAR'S MOST FASCINATING NEWS AND COOLEST INVENTIONS

RACE INTO SPACE

On 6 February at 3:45pm at the Kennedy Space Center in Florida, space transport company SpaceX launched the Falcon Heavy, the most powerful operational rocket in the world. Around eight minutes later, the rocket released a cherry-red Tesla car 'driven' by a spacesuit-wearing mannequin.

A few hours after the rocket launch, Elon Musk, the billionaire boss of Tesla and SpaceX, spoke of his ambitions for space travel. "I think it's going to open up a sense of possibility," he said. "We want a new space race. Races are exciting."

The original space race was a competition between the USA and the Soviet Union in the 1950s and 1960s. Each nation wanted to be the first to put satellites – and people – into space.



GREEN-HAIRED 'PUNK' TURTLE ADDED TO ENDANGERED LIST

The Mary River turtle is an Australian reptile that can stay underwater for up three days, thanks to its ability to breathe through gill-like organs in its genitals. In April, the Zoological Society of London (ZSL) added it to a list of the world's most vulnerable reptile species.

At the top of the list is the Madagascan big-headed turtle. Other additions include the gharial, a freshwater crocodile once common across much of Asia but now confined to a handful of rivers in northern India and Nepal, and the Round Island keel-scaled boa, a non-venomous snake found in Mauritius that can change colour over a 24-hour period. "Just as with tigers, rhinos and elephants, it is vital we do our utmost to save these unique and too often overlooked animals," said ZSL's Rikki Gumbs.

IT'S A FACT

The punky green 'hair' on the turtle is actually algae that grows on its head and body



ZOOM INTO THE SKY

Zapata's new jet-powered hoverboard, the Flyboard Air, can reach heights of 3,000m and whizzes along at 140km/h. It can manage up to 10 minutes of flight on a full tank of fuel, long enough to travel around four kilometres. The board's inventor, Franky Zapata, is the only person trained to fly the Flyboard Air, but the company also has a safer version called the EZ-Fly. If you fancy it, you could take to the skies too. All you need is some spare time for training, a cool £213,000, and a daredevil streak.



NASA SPACECRAFT PEERS AT JUPITER'S STORMY WINDS

This awesome snap of Jupiter's south pole was captured by NASA's Juno space probe on a flyby at the beginning of the year. It shows a swirling mass of storms unlike anything else in our Solar System.

Juno entered Jupiter's orbit in July 2016. It has repeatedly zoomed over the planet, peering deep beneath the clouds into the atmosphere below

and studying its auroras, structure and weather.

The information from Juno shows violent cyclones that stretch deep into Jupiter's atmosphere. Its north pole features a central cyclone surrounded by eight smaller ones, while its south pole contains a central cyclone surrounded by five smaller cyclones.

Auroras are natural phenomena that occur when the Sun interacts with particles in the planets' atmospheres, creating swirling, flashing colours in the sky. On Earth, these are seen as the Northern Lights.



FLYING SOLO

Here's one for the Christmas list: a lightweight, single-person drone plane that you can pilot yourself after just a few hours of training.

The 'Flyer', which has been created by the start-up company Kitty Hawk, has 10 battery-powered propellers and weighs 113kg. The pilot has two controls: a joystick for direction, and a slider for speed, with no other

instruments or screens. An onboard computer keeps the Flyer level.

It can fly at a height of three metres, has a top speed of 32km/h (20mph), and the battery can power just 20 minutes of flight at a time. Okay, so it might not be able to fly you on holiday to Spain, but we still think it looks like loads of fun!



BURST THE BUBBLE!

In the Netherlands, 1.5 million kilograms of gum end up stuck to the pavements every year. A group of companies is pulling that gum off the streets, to make a material called Gum-Tec. They have used Gum-Tec to create trainers called GumShoes, which come in bubblegum pink or black.

To celebrate GumShoe's origins, each sole has an Amsterdam street map printed in its tread, and the companies want to expand the project to other major cities.

NASA, GETTY, KITTY HAWK



SPACE HOLIDAYS IN 2022?

Like planning ahead? Aerospace company Orion Span claims its Aurora Space Station will be ready for holidays in 2022! Your trip will start in Cape Canaveral, Florida, where you'll be launched 320km above the Earth's surface to board Aurora for a 12-day stay.

The trip will set you back a whopping \$9.5m per person (£6.7m approx), so you'd better start saving your pocket money. Holidaymakers need to complete three months of training before the trip, most of which can be done online. Once you're in space, you'll be able to float around in zero gravity and take part in experiments, such as trying to grow food in orbit (space salad, anyone?). The Aurora Station will complete an orbit of Earth every 90 minutes, so you'll have loads of opportunities to gaze down on your favourite places – you can post any snaps you take to Instagram via the station's high-speed internet connection.



IT'S A FACT

One of the stolen spiders was a six-eyed sand spider, which is highly venomous

BUG BURGLARS!

In August this year, thieves stole almost 7,000 insects, spiders and reptiles from Philadelphia Insectarium and Butterfly Pavilion in the USA. Security cameras recorded the culprits taking the creepy-crawlies out of their enclosures and sneaking them away in boxes, and police believe it was an inside job. In total, 80 per cent of the collection was stolen, worth more than £30,000. It is

thought that the thieves wanted to sell the animals into the pet trade, as they can fetch loads of money. Part of the building is now closed, but the team are getting lots of new animals and hope to reopen in November.





Uranus smells like rotten eggs

If we ever get to enjoy space holidays, we probably won't want to go to Uranus – it's apparently a bit stinky! This year, scientists have learned that its upper atmosphere contains hydrogen sulphide – the gas that gives rotten eggs their whiffy stench. "But that's not the worst of it. Suffocation and exposure in the -200°C atmosphere made of mostly hydrogen, helium and methane would take its toll long before the smell," said the University of Oxford's Prof Patrick Irwin, who led the research.

ORION SPAN, GETTY X2, NASA, SHUTTERSTOCK

LIQUID WATER ON MARS

At the end of July, scientists from the European Space Agency (ESA) announced that there is liquid water on Mars. The discovery of an underwater lake below a glacier in Mars's south polar region was made using the Mars Express probe, which has been flying around the Red Planet since December 2003.

While the surface of Mars is far too cold for water to exist in liquid form, the thick covering of ice at

the poles acts like an igloo, trapping what little heat Mars emits from its core.

Mars's underwater lake is similar in many ways to Lake Vostok here on Earth, which lies beneath four kilometres of ice in Antarctica. Scientists think that there could be tiny undiscovered creatures in Lake Vostok, so there is a chance there could also be life in this Martian lake.

Facial recognition lets teachers spy on pupils

Students in China should watch out! Three cameras have been installed above a blackboard at Hangzhou Number 11 High School in China to identify pupils who aren't focused on their lessons. It's called a 'smart classroom behaviour management system', or 'Smart Eye'. The cameras scan students every 30 seconds and recognise seven facial expressions: neutral, happy, sad, disappointed, angry, scared and surprised. It can also identify actions such as reading, writing or sleeping. If the system spots a student who isn't paying attention, it sends a notification to the teacher.





The Mariana Trench is the deepest point in the world's oceans. The very bottom is 11,034m below the surface of the sea.



A helicopter is going to Mars

NASA has built a helicopter that will travel to the Red Planet as part of the Mars 2020 Rover mission. The helicopter weighs just under two kilograms and has two rotors stacked on top of each other that spin in opposite directions at almost 3,000rpm – 10 times the rate of a helicopter on Earth – to keep it in the air in the thin Martian atmosphere. Its batteries are charged via solar power and it is fitted with a heating mechanism to prevent it from freezing during the chilly Martian nights.

The helicopter will be delivered to the Red Planet by the Mars 2020 rover, and will then pilot itself on its first flight.

ADAM SUMMERS/UNIVERSITY OF WASHINGTON, NASA, DISNEY

WEIRD SEE-THROUGH FISH SPOTTED

Head 8,000 metres down into the Mariana Trench in the western Pacific and you might just bump into this guy – the Mariana snailfish. Down on the seabed at this depth, conditions are brutal: pressure is extreme, temperatures rarely reach 2°C, and it's almost pitch black. But the Mariana snailfish, the deepest dwelling fish ever discovered, thrives where normal fish would be squashed flat.

Researchers from the University of Washington used traps to capture 37 of the fish so they could study them. Unlike other deep-sea fish, this species has no fearsome features such as large teeth. Instead, it's small and see-through, with no protective scales. Despite this, it's a top predator of the area, swallowing tiny creatures whole. In the image above, a snailfish's last meal of a crustacean can be seen glowing green in its stomach. Yum!

DISNEY ROBOTS ARE AWESOME ACROBATS

Disney's new stunt robots can flip through the air like expert trapeze performers, hitting the nets perfectly every time.

Disney researchers originally created Stickman, a long, thin robot capable of tucking up into a Z-shape for a smooth backflip. They've been improving Stickman at a rapid pace and have now introduced Stuntronics (pictured), which is their next-generation somersaulting robot.

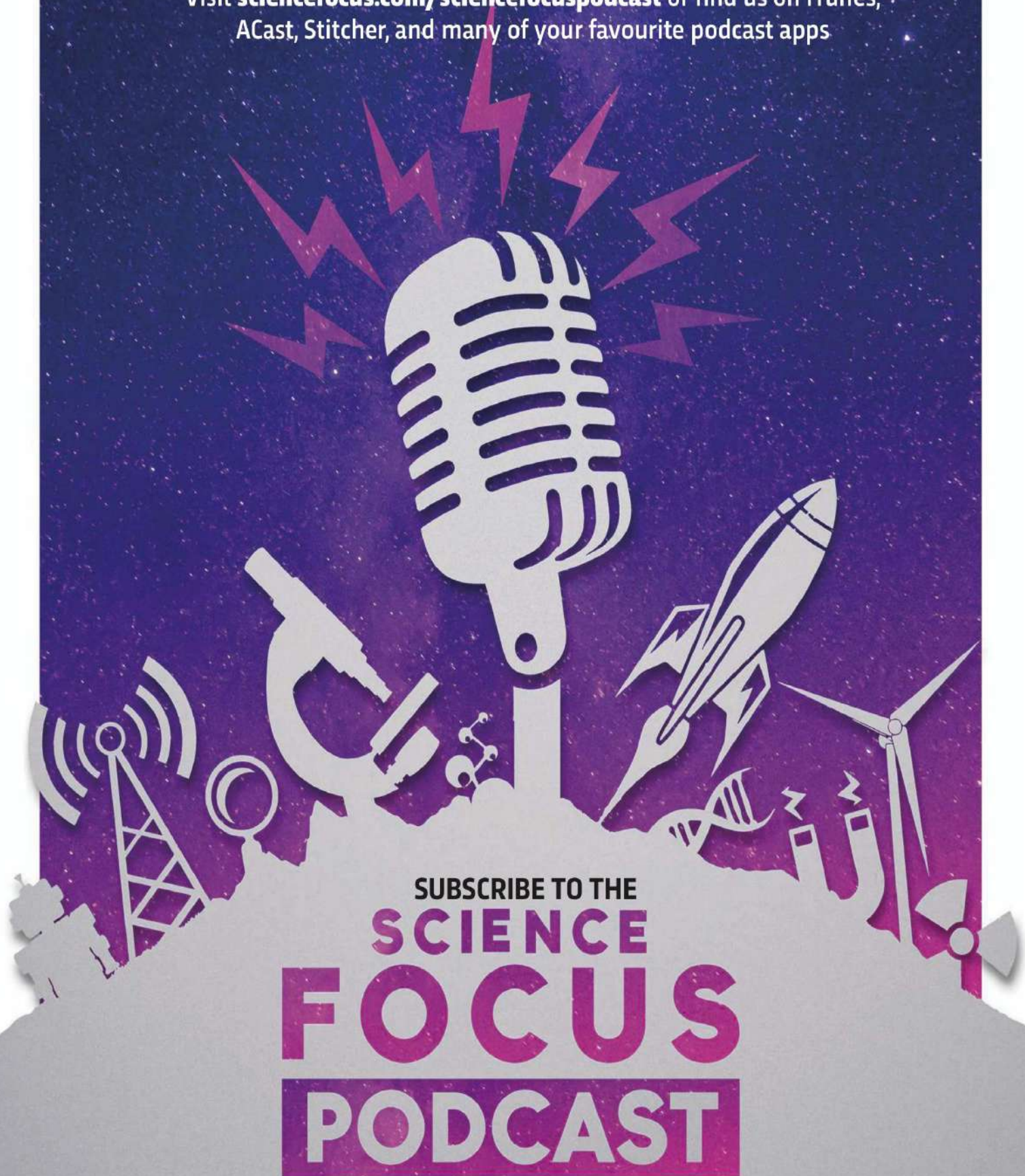
After being flung from the end of a wire, the 41-kilogram figure can somersault, twist, and then extend its legs to slow down and make a perfect landing.

Disney's mission is to create realistic robot figures that can perform tricky acrobatic stunts at its theme parks. 🤖



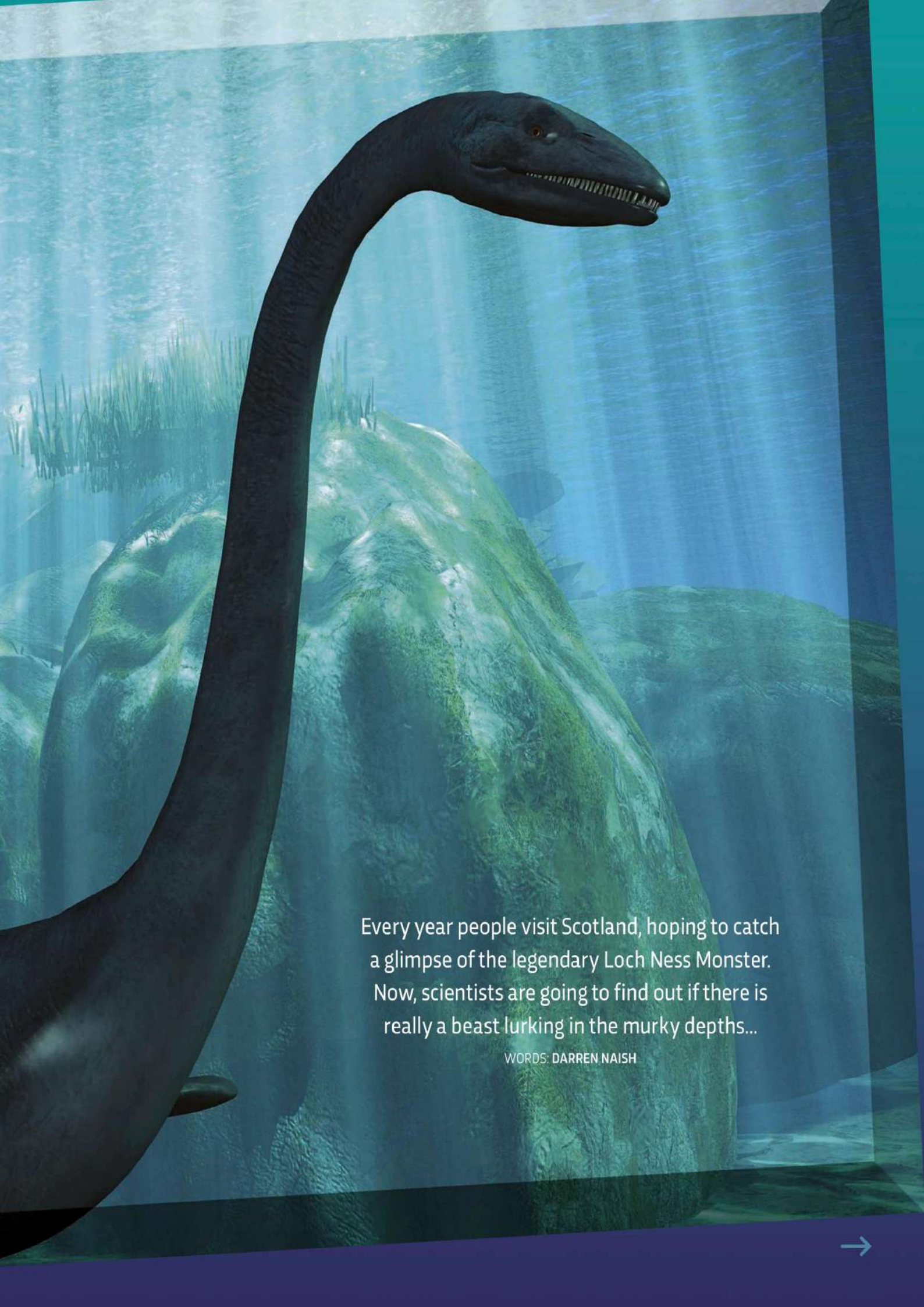
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Exoplanets • Altruism • Moon bases • Transhumanism • Dinosaurs
and much, much more

WILL WE EVER FIND NESSIE?



Every year people visit Scotland, hoping to catch a glimpse of the legendary Loch Ness Monster. Now, scientists are going to find out if there is really a beast lurking in the murky depths...

WORDS: DARREN NAISH





1



2



3

❶ This image, known as 'the Surgeon's Photograph', was taken in 1934. It became famous, but was later found to be a fake

❷ Every year, sightseers flock to Loch Ness in the hope of spotting a monster

❸ Loch Ness is about 37km long. Its water is especially dark, as it contains a lot of peat from the surrounding soil

❹ Prof Neil Gemmell is hunting for Nessie using eDNA

Back in 1933, a man called George Spicer and his wife were driving along a road near Loch Ness. Suddenly, a weird animal with a long neck crossed in front of the car... or so the Spicers claimed. Ever since then, the Loch Ness Monster has been a household name, although myths of a terrifying creature in the loch date back to the Dark Ages.

Since the Spicers' experience, scientists have been wondering whether such an animal might really exist in the loch's murky depths. Research teams have patiently watched Loch Ness's surface for weeks at a time, submarines have explored its deep, dark waters, and underwater cameras and sonar have scoured it. Most of this work happened from the 1960s to 1980s, during a 'golden age' of Nessie hunting. Yet no monster has been found.

Nevertheless, there have been more than 1,000 reported sightings in total, and every year tourists visit the loch in the hope of catching a glimpse of a monster. But there is no reason to think that anyone has *really* seen Nessie. Instead, they have seen seals, birds, swimming deer and unusual waves.

Despite this, the idea that Nessie might be real is still popular. So earlier this year, Prof Neil Gemmell from the University of Otago in New Zealand led a trip to Loch Ness, using a new scientific technique to help find Nessie and solve the mystery once and for all. He set out to search for something called 'environmental DNA', or eDNA for short. (To find out more about eDNA, see opposite page.)



What is environmental DNA (eDNA)?

All life contains DNA. How DNA is structured – how its sections are arranged – varies from one species to the next. As a result, **if scientists find a skin fragment, a tooth, a bone** or some other part of an animal, they can collect DNA from it and **find out what animal it comes from.**

During the 1990s, scientists realised that **skin cells, saliva, urine and dung** can be collected from the environment and tested for DNA. **This is environmental DNA – eDNA** for short – and it has now been discovered in soil, ice, streams, ponds and even the ocean.

Once an interesting **sample of ice, soil or water** has been collected, it is **analysed in the laboratory for DNA traces.** Any DNA fragments that are discovered are copied and **compared with existing DNA records** to see which species can be identified in the sample.



Most eDNA discovered so far belongs to living species already known to science. However, some eDNA has been found from **extinct animals, like mammoths and giant sloths.** This proves that eDNA can last for thousands of years if the conditions are right.

Perhaps **the most exciting eDNA results** are those that reveal an animal that's **previously been unrecorded** in the area being studied. Several eDNA projects on seawater have found evidence for **animals that were otherwise unknown** from the area, including sharks and whales.



What could Nessie be?

STURGEON?

Sturgeons are prehistoric-looking fish (sometimes more than five metres long) that swim up rivers during the breeding season. Some Nessie sightings could be of sturgeons.



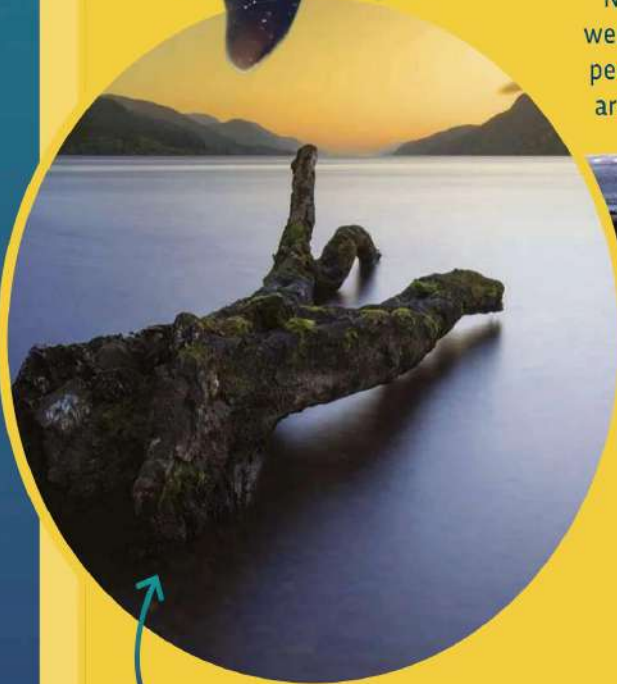
WEIRD WAVES?

Movements in the rock layers deep below Loch Ness could result in weird waves that make people think that they are seeing a monster.



GIGANTIC EEL?

Some experts suggest that Nessie could be a gigantic eel that has become trapped in Loch Ness and has simply grown to an enormous size.



FLOATING TREE TRUNKS?

Floating masses of vegetation and tree trunks sometimes emerge on the surfaces of big lakes. A few Nessie sightings might be explained in this way.

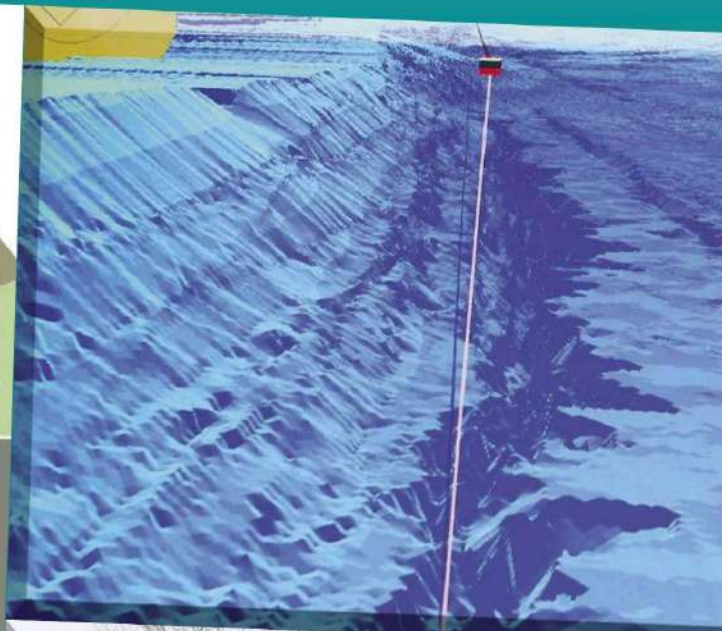
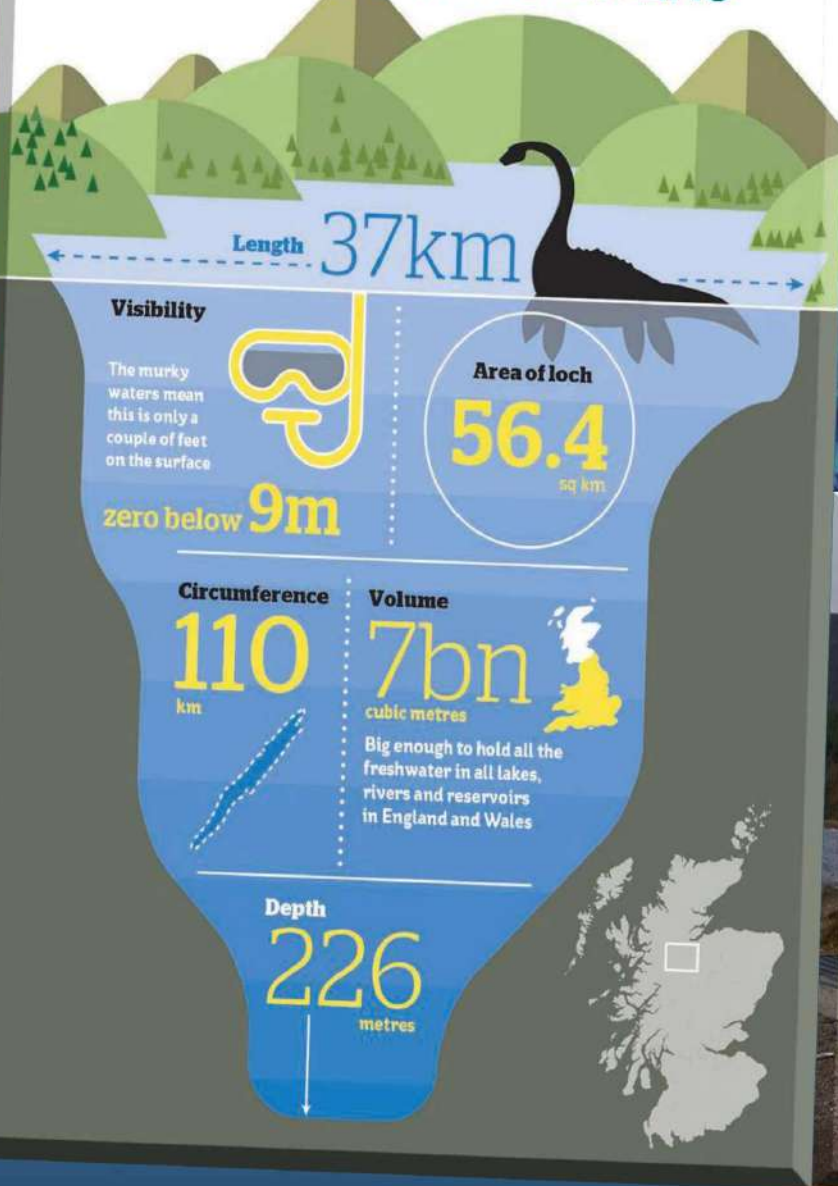


PLESIOSAUR?

Plesiosaurs were marine reptiles that died out 66 million years ago. The idea that Nessie might be a surviving plesiosaur remains a popular idea.



LOCH NESS IN NUMBERS



eDNA has helped us find all kinds of rare, shy and even extinct animals and plants, so Gemmell wondered if eDNA could be collected from samples of water taken from different points of Loch Ness. He put together a research team, raised the money needed to complete the project, and set to work.

Right now, we are still waiting for the results from Gemmell's project. But even if eDNA evidence for Nessie is not discovered, the project is still useful, because it could help provide a complete list of every plant and animal species living in Loch Ness.

What's great is that this project has captured the imagination of the public, including children, and Gemmell and his team have had loads of opportunities to talk about their exciting research, and about eDNA and DNA in general.

So will this project really solve the mystery of the Loch Ness Monster? Maybe it will, maybe it won't. But either way, it has to be considered a success. Not only will it help us find out exactly what wildlife lives in Loch Ness, but it has also got people super interested in the science behind it. We can't wait to find out what's hiding in the water! 🐾

TOP: This sonar reading of Loch Ness, taken by a tour boat captain, revealed a deeper section known as Keith's Abyss, which some people think could be a hiding place for Nessie

ABOVE: The home of Steve Feltham, a man who is a full-time Nessie hunter

Joyride junkyard

These bicycles have been abandoned in a disused school playing field in China. The bikes started life as part of a number of shared cycle schemes, to help reduce traffic jams in China's bustling cities. People could hire the bikes on their way to work using a smartphone app, then park them up when they'd finished their ride. However, staggering numbers of the shared bikes were discarded in dangerous places, such as narrow pavements, meaning that many had to be removed. Now, over 10,000 confiscated bikes have ended up in the school field.

PHOTO: EYEVINE



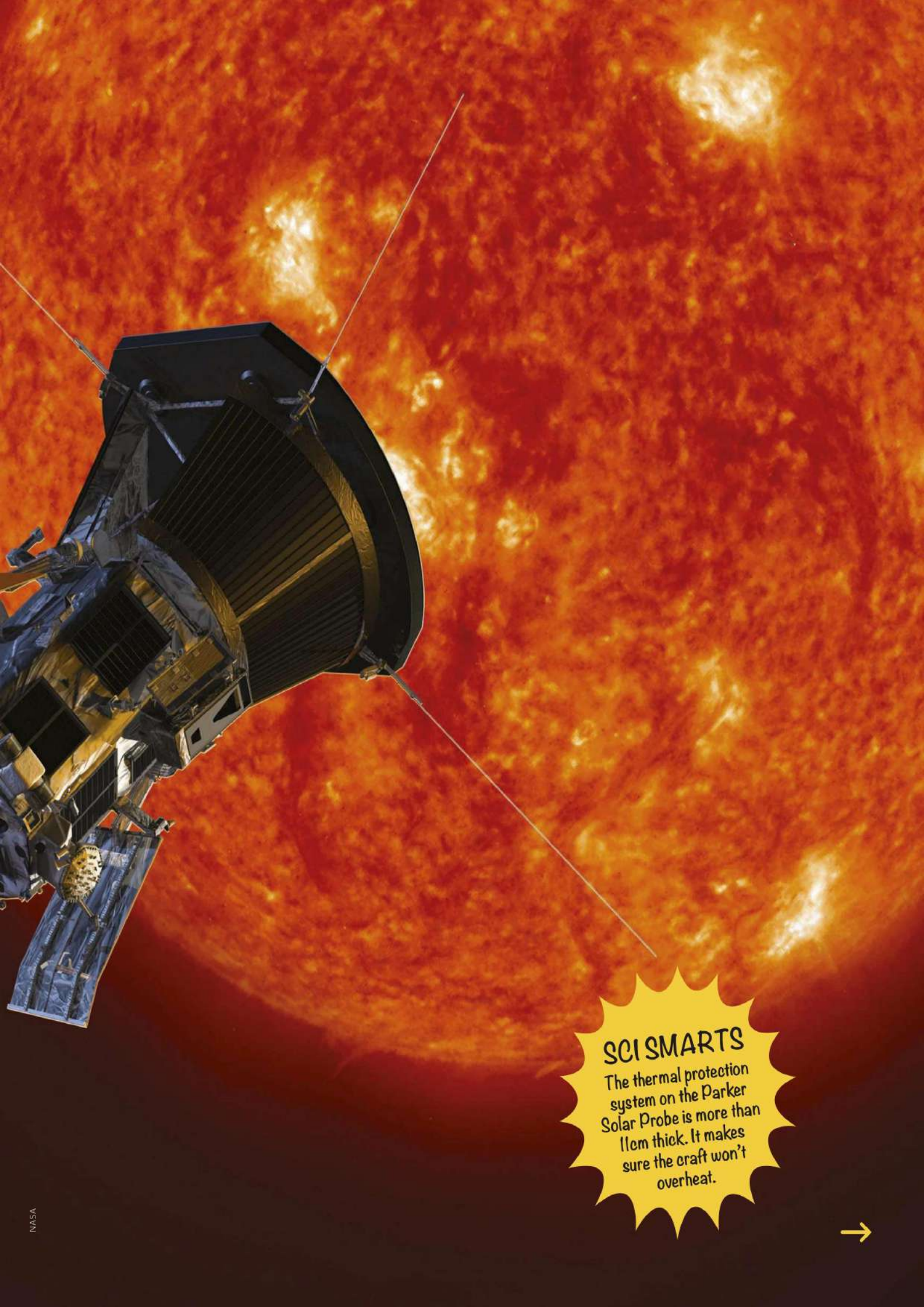


COULD A SPACESHIP FLY INTO THE SUN?

The Parker Solar Probe is currently zooming its way across space towards the Sun. But just how close will it get, what will it find, and will it survive its daredevil mission?

WORDS: ELIZABETH PEARSON





SCI SMARTS

The thermal protection system on the Parker Solar Probe is more than 11cm thick. It makes sure the craft won't overheat.





The Parker Solar Probe blasted off on 12 August this year

SCI SMARTS

The Parker Solar Probe is named after Dr Eugene Parker, who first predicted that the solar wind exists.

The Sun is the most important thing in our Solar System. Its gravity keeps the planets in place and its heat and light supports life on Earth. Yet we know little about it. That will soon change, as NASA has sent a spaceship that will reach out and touch the Sun – the Parker Solar Probe.

Parker will get seven times closer to the Sun than we've ever been before, arriving just over six million kilometres away from it. That might not sound very close, but in space terms it's right next door.

It's not going to be easy. To get into the Sun's orbit, Parker doesn't just have to travel the 150 million kilometres to reach it – it also has to match the Sun's speed. The faster Parker goes, the closer it can get

to the Sun. So when Parker left Earth on 12 August 2018, it was launched towards the Sun three times faster than anything we've put into space before.

Parker's current orbit loops from out beyond Venus, then moves in towards the Sun and back out again. It has to back away from the Sun because even though Parker has a heat shield to reflect most of the sunlight, it wouldn't be able to survive if it was always in close.

This looping orbit also gives Parker the chance to get a speed boost from Venus using something called a 'gravity assist'. This is where a spacecraft flies past a planet and gets pulled along by gravity. The craft is only dragged with the planet for a few seconds, but it ends up travelling much faster.

ABOVE LEFT: The Parker Solar Probe being assembled

ABOVE: In this image of a solar eclipse, the bright centre of the Sun is being blocked out by the Moon, which means the corona can be seen



INSTANT GENIUS

Get the lowdown on the Sun and the Parker mission

How fast will Parker go?



Parker is travelling at 690,000 kilometres per hour – fast enough to whizz around Earth in three and a half minutes.

Won't Parker melt?



Parker's heat shield reflects almost all the heat from the Sun. NASA is actually more worried about Parker getting too cold when it's out by Venus, so it has heaters to keep it toasty warm.

Is the Sun like other stars?



Stars come in all sizes. A lot are the same size as the Sun. Most are smaller. The largest that we know of is 1,700 times as big. Their colours vary too, from dark red to the Sun's white to bright blue.

What's the Sun made from?



The Sun was once made of a superhot gas called hydrogen. Over time, it has cooked some of the hydrogen into other elements, like helium.

How hot is the Sun?



The surface is 5,500°C, but deep down it could be thousands of times hotter. The corona is hotter too.

How big is the Sun?



It's 1.4 million kilometres across. You could fit over a million Earths inside it!

How old is the Sun?

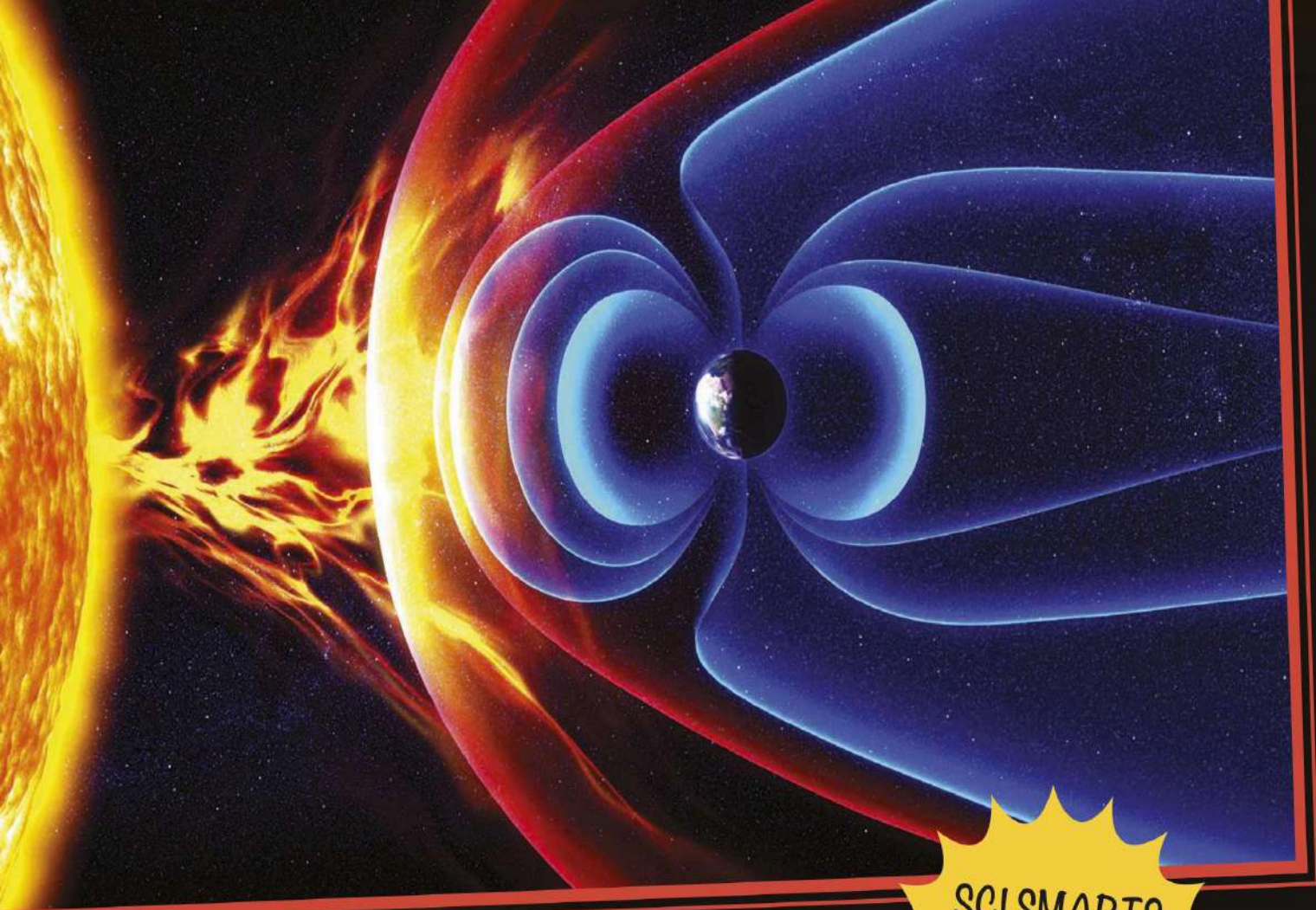


About 4.5 billion years old.

"The spacecraft will fly right through the Sun's outer layer"

Parker gets its first speed boost in November this year. Over the next seven years Parker will fly past Venus another six times. Each time it does, the spacecraft will have a speed boost and get a little nearer the Sun. Eventually the spacecraft will be going fast enough to zoom right through the Sun's scorching outer layer, the corona.

The corona is a cloud of superhot gas called plasma, which surrounds the Sun. Normally, we can't see the corona because it's dim and the Sun is bright. It's like trying to look at a tablet screen outside when the Sun is shining – you can't see anything! You can only see the corona during a solar eclipse when the Moon blocks out the bright centre of the Sun, revealing a wispy 'crown' →



"Parker is venturing where humanity has never been before. Who knows what we might find?"

ABOVE: Earth's magnetic field (coloured blue in this image) protects us from the solar wind and solar flares

reaching out from where the Sun should be ('corona' is the Latin word for 'crown'). Parker, however, will fly right through the corona, giving us a look at a region we don't know much about.

What scientists have learned about the corona already has made them even more curious. It's hot. Really hot. Temperatures in the corona can be a thousand times hotter than the surface of the Sun! That just doesn't make sense. If you walk away from a fire, the air gets colder. So why does the corona get hotter as you move further away? No one knows, but with Parker, the astronomers at NASA might be able to find an answer to the mystery.

Learning about the corona isn't just about satisfying NASA's curiosity,

SCI SMARTS

Astronomers think the Sun will die out in about 10 billion years' time. Before that, it will turn into a red giant star.

though. It could also help us to protect devices here on Earth. When the corona gets far enough away from the Sun, it turns into something called a solar wind, which blows across the rest of the Solar System. This wind has a lot of energy, which makes it dangerous. Humans are safe from it here on Earth, but the satellites we rely on for communication and GPS aren't so lucky. If scientists can understand the corona and the solar wind, then it can help keep our satellites functioning when solar winds hit.

But the most exciting things Parker will find are the mysteries we haven't even thought of yet. It is venturing where humanity has never been before. Who knows what we might find by flying through the edge of a star? **f**

THE SUN

It's so much more than a fiery ball...



CHROMOSPHERE

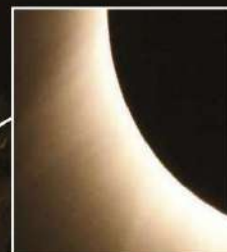
A thin layer that appears as a red flash at the start and end of an eclipse.

PHOTOSPHERE

The only bit we can usually see from Earth.

THE CORONA

The Sun's outer layer. It eventually blows away to create solar winds.

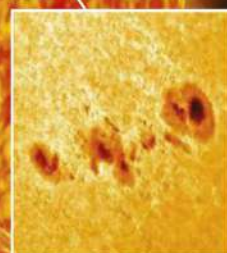


RADIATIVE ZONE

The energy made in the core moves outward through this layer.

CORE

The Sun's energy factory, where it creates heat and light. It can take over 100,000 years for light to move from the core to the surface.



SUNSPOT

Dark spots on the Sun's surface.



FLARES

Occasionally a prominence will escape from the Sun, becoming a flare.

CONVECTION ZONE

The heat makes the plasma (superhot gas) tumble about.



PROMINENCES

Huge plumes of plasma that erupt out of the Sun, forming loops and sheets.

WOW!
LEARN TO CODE
AND CAST
SPELLS



Cast a spell and
make Bertie Bott's
Every Flavour
Beans grow bigger!




CODE SOME MAGIC

Unleash your inner Harry Potter or Hermione Granger with a wave of this wand

Still no letter from Hogwarts? Never mind, while you're waiting you can build your very own wand, without ever having to make a trip to London to visit Ollivanders.

The Harry Potter Kano Coding Kit comes with a magic wand, batteries and circuit board that you assemble yourself. Once you've built it, connect it wirelessly to a tablet or computer via the *Kano* app. Thanks to a gyroscope (that senses gravity), accelerometer (that knows your speed), and magnetometer (that calculates direction), the wand reads your hand movements so you can swish and flick to your heart's content. You then start coding the wand so you can cast all sorts of spells, including 'Stupefy', 'Incendio', and 'Wingardium Leviosa'.

Don't worry if you've never coded before. The wand leads you through puzzles and challenges across six iconic locations – including Hogsmeade, Hogwarts and the Forbidden Forest – to take you from beginner to expert faster than Harry can spot a Golden Snitch. Once you've mastered all the spells, you start modifying the code to create your own. Dumbledore would be proud! 

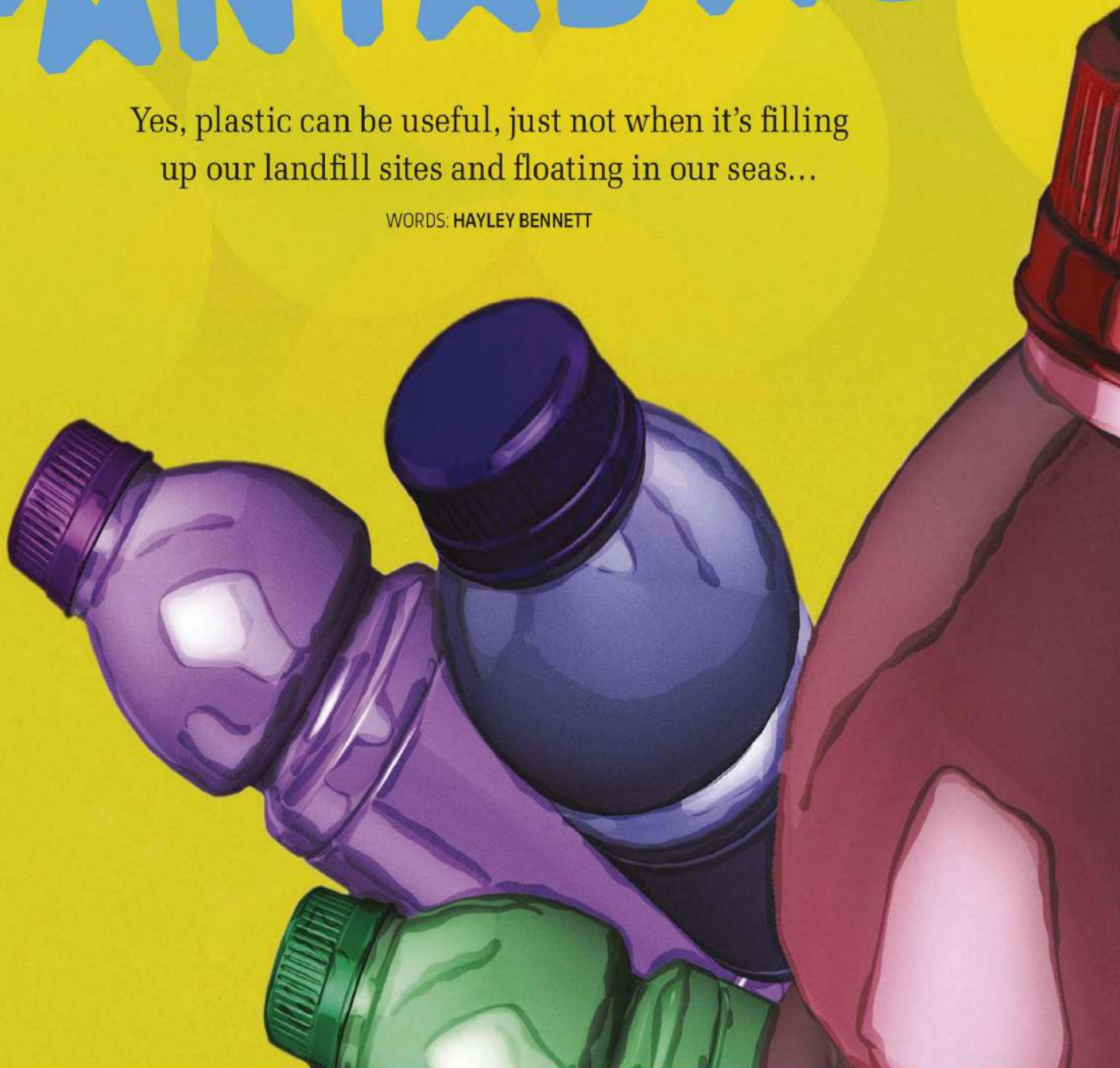


Harry Potter
Kano Coding Kit
£99.99,
kano.me

WHY ISN'T PLASTIC FANTASTIC?

Yes, plastic can be useful, just not when it's filling up our landfill sites and floating in our seas...

WORDS: HAYLEY BENNETT





Do you know how many times a day you use something made from plastic? It starts as soon as you get out of bed in the morning and put on your clothes. You might not have realised it but it's very likely that your shirt, socks and even your underwear contain plastic threads that make them cheaper, stronger and stretchier, or even easier to wash.

After putting your clothes on, there's breakfast. Cereal comes out of a plastic packet and so does the bread for your toast. Then you'll probably clean your teeth with a plastic toothbrush and brush your hair with a plastic comb. Plastic is actually a name for a big group of substances that includes everything from hard building materials

SCI SMARTS
The Great Pacific Garbage Patch is the largest collection of floating rubbish on Earth. It is located between California and Hawaii.

to soft fabrics, and it has become a part of everything we do in our daily lives because it's long-lasting and strong. But this also makes it incredibly difficult to get rid of.

PLASTIC PLANET

Not so long ago, plastic didn't exist. Only a few decades back, people wore clothes made of cotton and wool, ate food that they bought in paper packets and brushed their teeth with toothbrushes that had bristles

"People who eat seafood may be consuming as many as 11,000 pieces of plastic a year"

A terrapin swims through plastic-filled water



made of pig hair. It all changed in the middle of the last century with the invention of plastics like nylon, which was soon used by clothing companies because of its strength and stretchiness. In Europe, around 80kg of plastic are currently produced each year for every person who lives here. That's more than the average adult weighs. On our planet, there are nearly five billion tonnes of plastic waste – more than 10 times the weight of the entire human population. All of this is mostly sitting in holes in the ground called landfill sites, or making its way to the seabed.

Whether plastic sits in the ground or washes into the ocean, it doesn't go away and it doesn't fully break down. Tiny pieces can enter the sewers and get mixed into the muck that we spread on fields where we grow our crops. At sea, little pieces sink into the mud and sand at the bottom, where they become impossible to recover.



OPERATION CLEAN-UP

Four solutions to the plastic problem

Stop flushing plastic. Items like wet wipes, contact lenses and disposable nappies contain plastics that block sewers and add to the plastic problem at sea. We should stop flushing them away and consider reusable items instead.

Ban single-use plastics. Under new EU laws, we're set to see the scrapping of drinking straws, plastic knives and forks, and other items that only ever get used once. Companies that can't avoid using them will have to pay for their clean-up.

Reduce fishing waste. Most of the plastic floating in the Great Pacific Garbage Patch is fishing gear, including nets and ropes. The same laws designed to reduce single-use plastics could also make the fishing industry responsible for its own waste.

Reuse and recycle. We can all do our bit by shopping second-hand and sorting our recycling, but there are more creative solutions too. Dutch engineers recently built a cycle path made from used plastic cups and bottles.

Large and small pieces of plastic are accidentally eaten by fish, birds and other sea creatures. While plastic might fill up their stomachs, it doesn't provide the energy and nutrients they need, so they end up starving to death. Plastic is also found in fish and seafood hauled in by fishing nets. It's thought that people who eat seafood may be consuming as many as 11,000 pieces of plastic a year. Yet it's not known exactly how harmful eating all of this plastic could be in the long-term – for other animals or us.

Last year, scientists worked out that if plastic waste carries on piling up

at the same rate that it is now, in 30 years' time there will be well over a tonne of plastic waste for every person on Earth. Of course, we won't be able to see all this waste because it will be under the sea or in landfill sites, but one way to think about it is to imagine if every person had to be responsible for an equal share of it. In that case, we'd each have a personal plastic mountain equivalent to over 50,000 used toothbrushes in our back gardens. We don't fancy that, so over these pages we've got some ideas that could help reduce our plastic usage...



SCI SMARTS

Unlike things like wood and food waste, plastic does not biodegrade. It will break into tinier and tinier pieces, making it hard to get rid of.





HACK YOUR PARENTS' SHOPPING TROLLEY

How many plastic-free points can you pick up when you help your mum or dad with the shopping?

Tick them off and add up your points! See how well you can do...

☐ **NAKED FRUIT AND VEG**

Who needs their potatoes in a plastic packet? Take a canvas bag with you, and grab the loose stuff.

3 points per item =

☐ **JUMBO SNACKS**

Multipacks contain lots of little plastic packets. So go for bigger, single packets of popcorn, crisps, yoghurt and nuts. Just promise not to pig out!

1 point per item =

☐ **GLASS JARS**

Pick peanut butter, spreads and sauces in glass jars and bottles that can be reused or recycled.

1 point per item =

How about making your own jam with naked fruits?

10 bonus points! =

☐ **OVER THE COUNTER**

Get meat or cheese at the counter, where it's often sold with less packaging.

2 points per item =

Some supermarkets will even let you take your own reusable containers.

5 bonus points =

☐ **THE LAST STRAW**

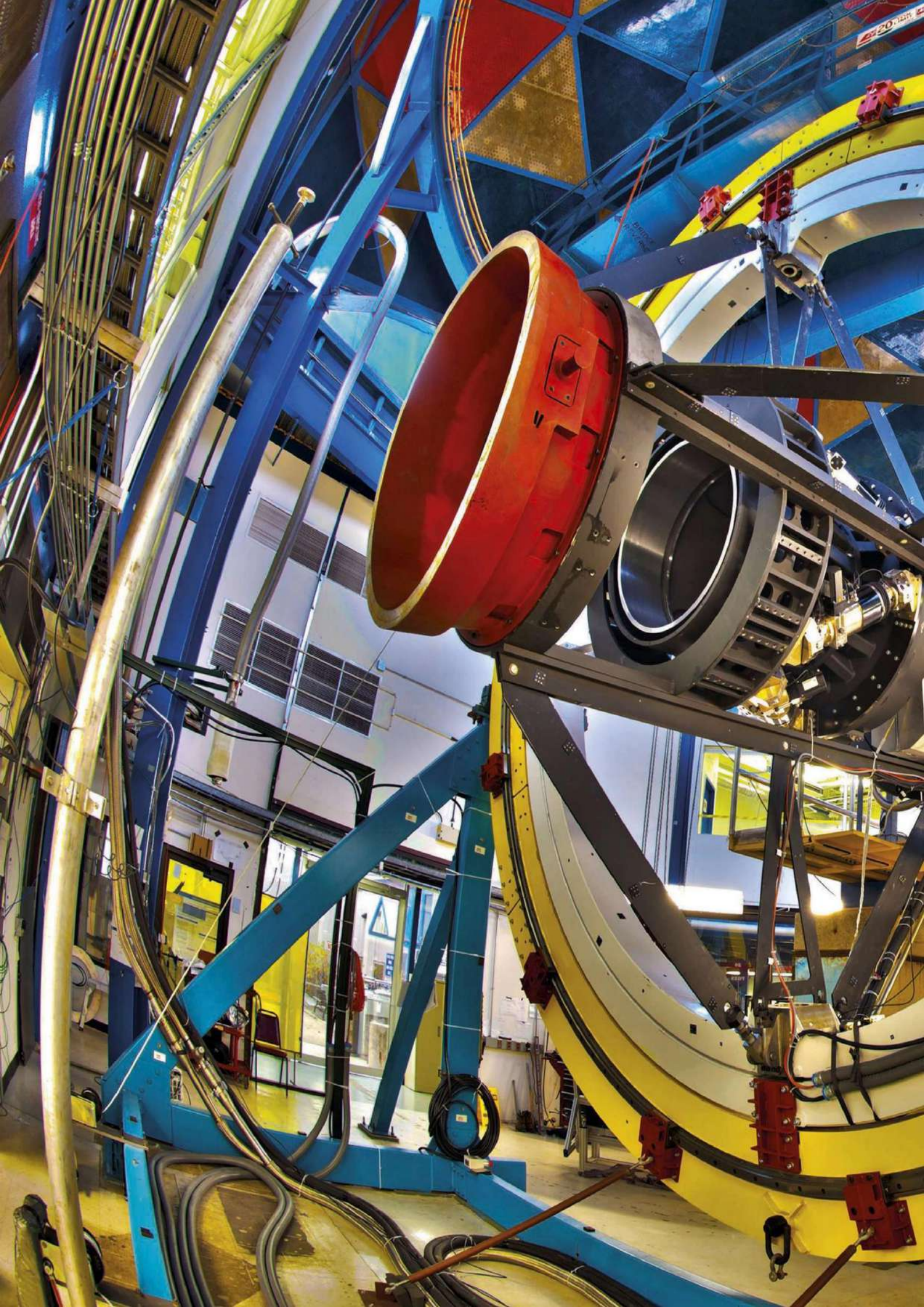
Having a milkshake in the supermarket cafe? Slurp it up without using a straw!

3 points =

TOTAL POINTS =



GETTY X2





Seeing in the dark

If you're going to solve one of the biggest mysteries in science, you need a suitably impressive piece of equipment. This four-tonne digital camera, called the Dark Energy Camera (DECam), is located at the Cerro Tololo Inter-American Observatory in Chile. The camera is trying to find out more about dark energy – the mysterious form of energy that's thought to be accelerating the expansion of the Universe.

DECam started carrying out a survey of the southern sky in 2013. Since then, it has recorded information from millions of galaxies, helping scientists to measure changes in the Universe's expansion (and dark energy) over the past 14 billion years.

PHOTO: SCIENCE PHOTO LIBRARY

EXPERIMENTS YOU CAN EAT

Transform your kitchen into a science lab

WORDS: MICHELLE DICKINSON

Candy crystals

Watch in awe as you grow your own edible, crunchy, candy crystals. The longer you leave them, the bigger they get!

3-7
days

You will need

- Tall, narrow, clean glass or jar
- 1 cup of water
- 2-3 cups of sugar
- Food colouring
- Wooden skewer
- Clothes peg
- Saucepan

Instructions

1. Heat the water in a saucepan over a low heat until it is simmering.
2. Slowly add the sugar, stirring constantly, making sure that it fully dissolves in the water before adding more.
3. Keep adding the sugar until the water starts to look cloudy. This is the point where no more will dissolve. You should end up with some leftover sugar.
4. Remove the pan from the heat and allow to cool.
5. Wet skewer with water, then roll it in the leftover sugar. Leave for a few minutes to dry.
6. Once the sugar solution has cooled, pour it into the glass or jar and add food colouring.
7. Clip the clothes peg onto the wooden skewer. Use the peg to suspend the skewer in the centre of the glass, so it's hanging in the liquid. The bottom of the skewer should be approximately 2cm from the bottom of the glass. Leave the glass where it will not be disturbed.
8. The crystals should form after three days and will continue to grow.
9. You can help your candy crystals to grow by checking for, and removing, any crusty film that forms on the surface of the solution.
10. When you are happy with the size of your candy crystals, remove from the solution and allow to dry for a couple of hours before eating.

The science behind it...

If you pour a spoonful of sugar into a glass of cold water and stir, the sugar will dissolve. Eventually, if you keep adding sugar to the water it will stop dissolving. However, if the water is heated, more sugar can be forced to dissolve in the water, creating what is called a 'supersaturated solution'. As the water cools, the supersaturated solution becomes unstable since it contains more sugar than it can hold. The sugar then starts to come out of the solution and reforms as solid sugar crystals. As it takes less energy for the sugar crystals to form on top of other crystals than to form on their own in the solution, the sugar-rolled skewers act as seeds for the new crystals to grow. The more the sugar solution cools, and the more water evaporates from the solution over time, the more the sugar comes out of the solution - and the bigger the crystals grow.

Eat these
crystals straight
off the skewer,
or stir into hot
drinks



Ask an adult for help when doing these experiments



Explore further...

- » Can you think of ways to flavour your candy crystals, maybe with peppermint oil or vanilla essence? Do you think this will change the structure of your candy crystals?
- » Can you make crystals with other crystal-forming materials such as salt? Do the crystals look the same or different?
- » How big will your candy crystals grow? Will they keep growing forever or eventually reach a maximum size? Why do you think that is?



Make
delicious
ice cream
in less than
10 mins



Instant ice cream

This delicious recipe will give you ice cream in under 10 minutes!
And best of all, you can add whatever flavouring you like...

10
minutes

You will need

- One small resealable sandwich bag
- One large resealable sandwich bag
- 120ml (1/2 cup) cream or full fat milk.
- 12.5g sugar
- A few drops of vanilla or other flavouring of your choice
- 3-7 cups of ice
- 75g salt

Instructions

1. Add the cream, sugar and vanilla to the small bag and seal, ensuring that any excess air is released.
2. Place the ice, salt and cream-filled bag into the larger bag and seal.
3. Vigorously shake the large bag over a sink for approximately five minutes. Stop when the cream has started to freeze and has turned into a solid.
4. Remove the small bag and quickly rinse off the salt solution with cold water.
5. Pour the ice cream into a bowl, add your favourite toppings and enjoy eating your newly frozen dessert!

The science behind it...

Ice cream is an emulsion, or a mixture of two liquids (water and fats) which do not normally mix together. To make ice cream, the milk or cream mixture needs to change its state from a liquid to a solid. If the mixture was simply placed straight into the freezer, the water component would freeze first, forming large, crunchy ice crystals. Ice cream tastes better when it is creamy rather than crunchy, so the goal is to create the smallest ice crystals possible. By vigorously shaking the bag, any large ice crystals that may be forming are broken up into smaller crystals, resulting in a smooth and creamy ice cream. The freezing point of ice is lowered by the addition of salt, so it starts to melt. As the ice melts it draws heat energy from its surroundings - including the cream mixture enclosed in the smaller bag - cooling it enough to cause the liquid cream emulsion to freeze, changing it from a liquid to a solid.

Explore further...

- » What happens if you do not shake the bag vigorously when making the ice cream?
- » If you put too much ice cream in your mouth, you may suffer from what is called 'brain freeze' or an 'ice cream headache'. Placing your tongue on the roof of your mouth should stop the headache - why do you think this is?
- » Taste the ice cream frozen, then taste it again when it has melted. One should taste much sweeter than the other - why do you think this is?



Unicorn noodles

These amazing and edible unicorn noodles can transform from purple to blue or pink right in front of your eyes...

30
minutes

You will need

- Large saucepan
- Knife
- Dried clear noodles (glass noodles work well)
- Large heatproof bowl
- Colander
- Red cabbage
- Lemon

Instructions

1. Roughly chop the red cabbage leaves and place in the saucepan.
2. Add enough water to the saucepan to half cover the cabbage leaves.
3. Bring to the boil and cook for five minutes on the stove.
4. Place a colander over a large heatproof bowl and strain the water from the hot cabbage.
5. Put the cabbage aside – if you like, you can add a pinch of salt and dash of vinegar to make it into a tasty side dish!
6. Pour the cabbage water back into the pan and add the noodles.
7. Simmer for 5-10 minutes, until the noodles are soft and purple.
8. Use the colander to drain off the water and transfer the noodles to a plate or bowl.
9. Squeeze fresh lemon juice onto the noodles and watch them turn pink!

The science behind it...

Red cabbage is purple due to a pigment called anthocyanin. This same pigment is also found in blueberries. As the cabbage boils, the anthocyanin leaches out into the water. When the dehydrated noodles are added to the cabbage water, the anthocyanin is absorbed. Scientists use a scale called the pH scale to describe how acidic something is, with 7 being neutral. A pH of less than 7 means the solution is acidic, while a pH greater than 7 means the solution is alkaline. Anthocyanin changes colour depending on the pH of the solution it is exposed to. When it is neutral (or at pH 7) it is purple, but if it comes into contact with something acidic such as lemon juice, it turns pink. An alkaline solution, on the other hand, would make the anthocyanin turn blue, green or even yellow. In addition to being a tasty snack, the unicorn noodles are also an edible pH meter!

Explore further...

- » What happens when you sprinkle an alkaline material such as baking soda onto the noodles?
- » Can you estimate the pH value of other household products – such as vinegar or laundry powder – using the leftover cabbage juice?
- » Using what you now know about anthocyanins, can you explain why the blueberries in blueberry muffins sometimes look green around the edges?





Jazz up
dinnertime
with these
colourful
noodles



A young woman with dark hair in braids, wearing a white lace top, is smiling and lighting a candle on a cake. She is holding a red-handled lighter. A woman in a blue top stands behind her, also smiling. The candle is decorated with chocolate chips. The scene is set in a kitchen.

Create a
pretty candle
that tastes
yummy too!



Confectionery candle

Many candles are thrown away after being used. However, with this delicious recipe you can have your candle and eat it!

20
minutes


You will need

- Matches or lighter
- Knife
- Plate
- Banana
- Almond
- Chocolate or nut pieces (optional)

Instructions

1. Peel the banana and cut the ends off to make a flat-based banana cylinder.
2. Stand the banana upright on the plate and decorate with chocolate or nut pieces.
3. Peel the skin off the almond and carefully cut lengthways to make a thin slice.
4. Push the almond slice into the top of the banana.
5. Use the matches to light the almond and watch it burn.
6. After the experiment, blow out the flame and eat the whole candle!

The science behind it...

Candles are made of two things, a wick and a wax. The wax acts as a fuel, providing energy to the flame, allowing the candle to burn. As the wax is usually solid in a candle, the heat from the flame softens it until it becomes a liquid. The wick then absorbs the liquid wax and pulls it up towards the flame. When the liquid wax reaches the flame it turns into a vapour or a gas that fuels the flame, keeping it burning. For a flame to continue to burn it needs fuel, energy and oxygen. The wax provides the fuel, the initial energy comes from the match, and the candle is surrounded by oxygen in the air. The edible candle also has initial energy from the match and has oxygen surrounding it. Instead of using wax, the edible candle uses the almond as both a wick and a fuel. Nuts are high in energy because they are filled with natural fats. These fats burn slowly and, when lit, provide fuel for the flame. The banana acts as a base for the almond to sit in, and its high moisture content keeps the flame safe and minimises the risk of the fire spreading. 

Explore further...

- » Do other types of nuts – such as cashews or walnuts – work as well? Which type of nut burns for the longest? What do you think that tells you about the nut?
- » Try other solid fruits as a base, such as an apple or an orange, if you prefer the taste of those.
- » Does the thickness of the sliced nut change how easy it is to light? Why do you think that is?



These edible experiments are taken from *The Kitchen Science Cookbook* by Dr Michelle Dickinson (£19.99, Nanogirl Labs).



ENGINES THAT RUN FROM BODY HEAT



Choose from kit or assembled at
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Julia Coats of the Animal and Plant Health Agency releasing a beaver back into a Devon river

Many UK species have disappeared over the centuries. We investigate whether they could be brought back

Can we return our lost wildlife?

WORDS: HELEN PILCHER

UK wildlife is in trouble, with more than half our species in decline. But a new conservation method called 'rewilding' could help make things better. Rather than trying to save one key animal or plant, rewilding aims to make huge areas of land wild again. Often it involves putting animals back into places they have disappeared from. These creatures then create opportunities for other species to thrive. As well as being good for wildlife, it is good for people, because we get the chance to explore these exciting places and might even get a glimpse of the animals, if we're lucky.



BEAVERS

Beavers fell trees, build dams and make ponds. This creates new places for water voles, otters and many other animals to live. Beaver dams filter the water and make it cleaner, and can help protect against flooding. In 2009, beavers were put back into Scotland's Knapdale Forest, making them the first wild mammals ever to be reintroduced to the UK. There are now beavers in Devon and in the Forest of Dean, and the hope is that they will be returned to many more rivers.



**DATE OF
DISAPPEARANCE:**
AROUND 400 YRS AGO
**CAUSE OF
DISAPPEARANCE:**
HUNTING



**DATE OF
DISAPPEARANCE:**
AROUND 100 YRS AGO
**CAUSE OF
DISAPPEARANCE:**
EGG COLLECTION,
TAXIDERMY AND
HABITAT LOSS

OSPREY

Ospreys are large, powerful, fish-eating birds of prey. They were wiped out of most of the UK by the 19th Century, but managed to hang on in Scotland until 1916. Then in the 1950s, ospreys from Europe flew to Scotland and began to breed. The English population was kick-started in 1996 when 64 young Scottish ospreys were transferred to Rutland Water, an East Midland nature reserve. When the birds grew up, they migrated to Africa, but came back every year to breed. Since then, over 100 ospreys have fledged from Rutland, and the bird is now making a comeback in Scotland, England and Wales.



**DATE OF
DISAPPEARANCE:**
AROUND 100 YRS AGO
**CAUSE OF
DISAPPEARANCE:**
HABITAT LOSS

PINE MARTENS

When their woodland habitat was destroyed, pine martens went from being one of the most common UK carnivores to one of the rarest, with the majority being restricted to the Scottish Highlands. Recently, they were reintroduced to mid-Wales where they are now breeding. Where pine martens thrive, red squirrel numbers go up and grey squirrel numbers go down. This is because greys are fatter and heavier, which makes them easier for the pine martens to catch. It's good news for the reds – they are our native squirrel species and have also been declining.



WOLVES

Wolves hunt large animals like deer. To avoid the wolves, the deer will keep moving, which means they don't nibble too many young trees in one area. As a result, wolves help turn grassland into forest. When they were reintroduced into the USA's enormous Yellowstone Park in 1995, trees shot up and wildlife flourished. Although wolves could survive here, we don't have the space they need and some people are worried they might kill farm animals. There are no plans to reintroduce them yet.

**DATE OF
DISAPPEARANCE:**
AROUND 250 YRS AGO
**CAUSE OF
DISAPPEARANCE:**
HUNTING





WHITE STORK

Storks build amazing twiggy nests that they add to year after year. Sometimes the nests become so big that other birds, such as house sparrows and starlings, nest within them. They are gradually being reintroduced to Sussex, where young birds from Europe are being raised in special pens. In time it's hoped the birds will breed with each other and with wandering birds from abroad. In fairy tales, storks bring babies to parents. It's thought their return will create opportunities for tourism, as wildlife-lovers and birdwatchers travel to see them.

**DATE OF
DISAPPEARANCE:**
AROUND 600 YRS AGO
**CAUSE OF
DISAPPEARANCE:**
HUNTING AND
HABITAT LOSS



WILD BOAR

Wild boar are nature's ploughs. They root through the undergrowth and turn over the earth creating new places for seeds to start sprouting. They also eat bracken, creating space for trees and other plants to grow. This attracts insects and birds.

In some places, like Kent and the Gloucestershire, wild boar escaped from farms and now live in the wild. With so many boar living wild already, there are no official plans to reintroduce any more.

**DATE OF
DISAPPEARANCE:**
AROUND 750 YRS AGO
**CAUSE OF
DISAPPEARANCE:**
HUNTING



EURASIAN LYNX

Lynx help woodlands regenerate by controlling the number of native roe deer and invasive species such as sika deer. They also eat foxes. Lynx are shy and live in forests, so there are many places in Scotland and northern England where they could exist. Experts are now deciding whether or not to release six lynx into Scotland's Kielder Forest as part of a five-year trial. The lynx would wear satellite collars and their activity would be monitored.

**DATE OF
DISAPPEARANCE:**
ABOUT 1,000 YRS AGO

**CAUSE OF
DISAPPEARANCE:**
HUNTING AND
HABITAT LOSS



REWILDING JUST AIN'T THAT EASY...

Rewilding is about more than just putting animals into wild places. It can also involve planting trees, pulling down fences and changing the routes of rivers. It's about restoring wild places to the point where nature can be left to look after itself. But not everyone is a fan. Farmers worry that introduced predators, like the lynx, could kill their animals, and that beavers might damage their land. Meanwhile, supporters of rewilding point out that trees give us oxygen to breathe, absorb carbon dioxide and help prevent flooding. Woodlands can be a rich source of food, medicine and fuel, and connecting with nature is good for our health and wellbeing. 🌿



Peekaboo!

Watch your step... this stargazer fish is waiting for a meal. So-called because of the eyes on the tops of their heads, stargazers use their fins as shovels to burrow themselves into the sand, leaping out to ambush any prey that passes overhead. Stargazers use their large, upward-facing mouths to create a vacuum, sucking in their unsuspecting prey. Some species can also create electric shocks of up to 50V, thanks to a specialised organ located behind their eyes – handy for warding off potential predators or confusing a potential snack.

PHOTO: REINART VAN METEREN



SCI SMARTS

Microbes, also called microorganisms, are tiny living things that you need a microscope to see. They include bacteria, viruses and fungi.





ARE THERE REALLY LOADS OF BUGS IN MY BODY?

Microbes are everywhere. They're all over your bed, your computer screen, this magazine, and your hands. Here, we're going to find out a little more about the ones in your body...

WORDS: ALICE LIPSCOMBE-SOUTHWELL

TRY THIS



Let's try an experiment. Stick out one finger, jam it in your belly button, and give it a wiggle. Now take your finger out, and give it a sniff. Smell a bit funny? Yes? That's all down to little bugs called bacteria, and belly buttons are crawling with them. This is because belly buttons are a great for trapping dirt and sweat, which the bacteria like to feed on. But it's not just your belly button – from the top of your head to the tips of your toes you are covered in bacteria, and if we delve inside your body we'll find that your insides, and especially your guts, are packed full of them. But don't be scared of them – most of them are your friends! Now wash your hands (and your belly button!) and we'll find out more.

MEET YOUR PERSONAL ZOO

So, we've established that you're covered with bacteria, but there are lots of other tiny organisms, such as viruses and fungi, that call your body home. All of these put together are known as the 'human microbiome', and scientists are discovering that they are super important.

Yes, we know what you're thinking: "But I thought bacteria and viruses were bad!" Well, you'd be right – some are really nasty. The flu virus, for example, can make you feel so ill you can't get out of bed, while bacteria that cause food poisoning might mean that you become best friends with the toilet for a couple of days. These bad ones are called 'pathogens'. However, some bacteria, fungi and viruses are helpful, while others might exist perfectly happily in one part of your body but only cause problems if they end up elsewhere. Each part of your body has its own distinct 'zoo' of microorganisms. So, the bugs

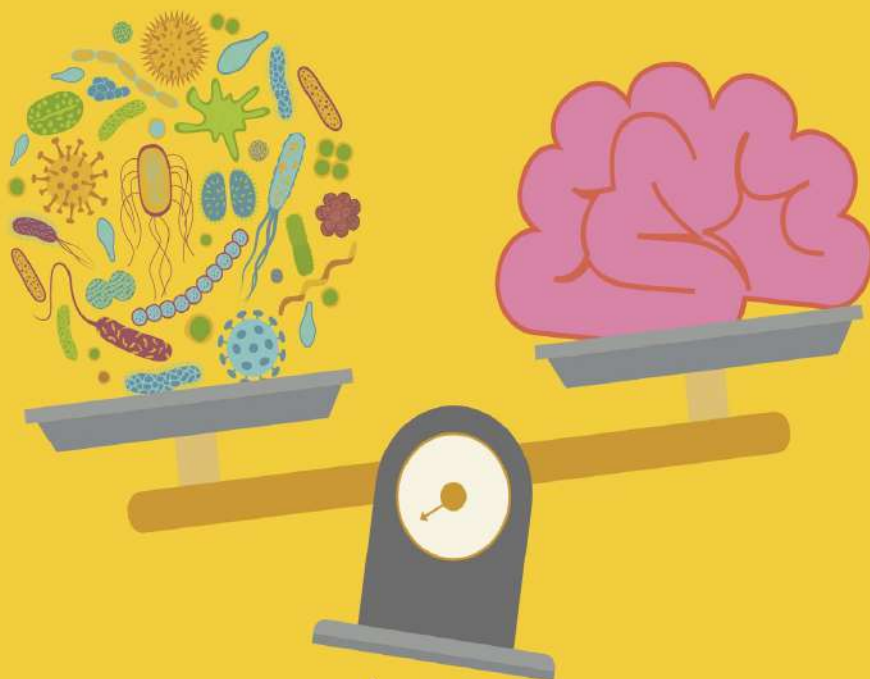
on your arm will be quite different to those in your mouth, which will be distinct from those on your feet or in your guts. It's a bit like going for a walk in the woods – on the floor there will be rabbits and foxes, in the trees there will be squirrels and birds, while underground there are earthworms and grubs.

But it's in the nooks and crannies of your guts, and especially your large intestine, that the vast majority of the microbes

Microscope image of mouth bacteria

live, and they are also the most important. While you can live perfectly happily without some organs, such as your tonsils or appendix, you wouldn't last long without your gut microbes. To give you an idea of just how many of them there are, if you put all of your gut microbes on a set of scales they would weigh more than your brain! They help you digest food, they affect what diseases you get, and might even play a part in whether you're fat or thin.

Incredibly, everyone's microbiome is unique, so yours will be different to your mum's, your brother's, or your best friend's. Experts think that if you have



HOW TO KEEP YOUR MICROBES HAPPY



STROKE ANIMALS
People living with pets have more diverse microbiomes



AVOID JUNK FOOD
Your microbes don't like it



DRINK GREEN TEA
It's fuel for microbes



EAT LIVE YOGURT
It contains lots of friendly bacteria



USE SOAP AND WATER TO SCRUB YOUR HANDS
Antibacterial washes kill good bugs as well as bad ones



EAT LOADS OF FRUIT AND VEG
Variety is important, as they will support different species of microbes



SPEND LOTS OF TIME OUTSIDE
It's great for your microbiome



EAT NUTS, SEEDS, BERRIES, OLIVE OIL AND GARLIC
They feed the good bacteria in your gut

lots of different species of bacteria in your gut, then you are less likely to get ill or suffer from allergies than people who have less diversity.

Scientists have discovered that some of the healthiest microbiomes on the planet can be found in the Hadza people, who live in a hunter-gatherer society in Tanzania, Africa. It is thought that their diverse microbiome is all down to their incredibly varied diet. On average,

Westerners manage to eat just 50 different species of plants and animals in a year; the Hadza munch their way through around 600, including porcupine, baobab, monkeys, tubers, honey and wild berries. According to Prof Tim Spector, a scientist who has visited the Hadza, they suffer from virtually none of the Western illnesses like obesity, allergies, heart disease and cancer.

But do you want to know what the best thing is? If you take a look at the ideas over these pages, you'll find that it's really easy to keep your microbes happy, and you don't even have to get on a plane to Tanzania to do it. Happy munching! 🍌

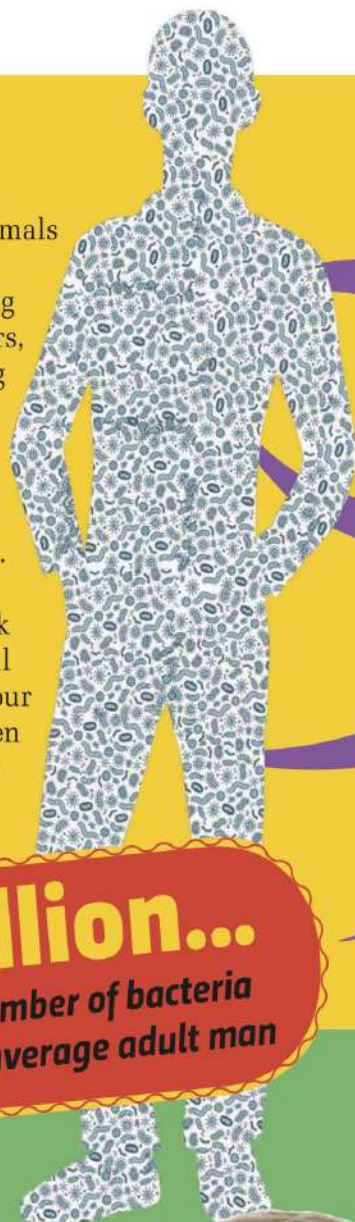
SCI SMARTS

Antibiotics are a type of medicine you take if you have an infection. They work really well, but as well as killing off the bad bacteria that are making you ill, they destroy some of the friendly bacteria too.

39 trillion...
The number of bacteria in an average adult man

POO TO THE RESCUE

It sounds pretty yucky, but people can actually be saved by someone else's poo. Certain diseases, or large quantities of antibiotics, can kill a lot of the good bugs in someone's gut, which will make them feel very ill. Scientists have found that if you take poo from someone who is healthy, you can turn it into a tablet that the sick person swallows. The bugs in the poo pill then make themselves at home in the patient's gut, and the person gets better. Just don't try this at home...



GUT FEELING

It's still early days for research, but it looks like your gut bacteria could also affect how you feel. The bacteria in your guts can send signals all the way to your brain, and certain microbes seem to be linked to whether you feel happy, sad or anxious.



WHERE DO THEY COME FROM?

Some of your microbes you are born with, while others you'll pick up from your environment and the food you eat. That's why it's really important to spend time playing outside and eating lots of different foods, as this can help you build a great community of little friends in your guts.

Scientist researching antibiotics in the lab



WHAT'S THE POINT OF HIBERNATION?



Snuggling down for a few months of rest might seem pretty tempting, but for some animals it's not a choice – it's a matter of survival WORDS: ALICE LIPSCOMBE-SOUTHWELL

Winter is coming, which means the temperatures are plummeting and food is in short supply. It's okay for us, we can still go to the shops and fill our baskets with tasty treats for the week ahead. But for wild animals, these are tough times. So rather than struggling, some species will find somewhere safe, and then slow their breathing and heartrate. In mammals, the body temperature will also drop. This means the animal uses much less energy to survive the winter, before waking up again when the weather is warmer.



1 Frogs and **TOADS** will see out the winter in leaf litter, in compost heaps or under piles of logs. Frogs may even bury themselves in the mud at the bottom of a pond, where they can 'breathe' through their skin.

2 Despite what many people think, **SQUIRRELS** do not hibernate. When it's bitterly cold, they'll stay cosied up in their nest, which is called a drey. They will venture out on warmer winter days to find food that they buried in the autumn.



3 The UK has a whopping 17 species of **BAT** that breed here. All of these hibernate from around November to April, when the insects they eat are hard to find. While hibernating, a bat's heart may beat just 20 times a minute – pretty amazing, because when they are flying it can reach 1,000 beats a minute.

4 **HAZEL DORMICE** have a loooooong hibernation period, from around October until May. But if the weather is especially bad, this may be

longer. In fact, they can spend up to three-quarters of the year 'asleep'! They will fatten up to twice their normal size before getting snug.

5 A number of British butterfly species, including the small tortoiseshell, **COMMA**, peacock and brimstone, will overwinter in sheltered areas. You may see them in sheds or garages. They'll be fine there until the weather warms up again. Other species might overwinter as eggs, caterpillars or pupae.

6 One of the UK's best-loved animals, the **HEDGEHOG**, needs to weigh 600g to survive hibernation. If hedgehogs visit your garden, you can help them by putting out non-fishy cat or dog food and a bowl of water at dusk every night.

7 It's not a British species, but the **NORTH AMERICAN WOOD FROG** is so incredible that we had to include it! When winter is coming, it will hide under some leaves, its heart will stop beating and it will freeze! When it warms up two to three months later, the frog will thaw out and hop off.



Before hibernation, animals will eat lots of food, which they store as fat. This provides their bodies with energy so they don't need to wake up and go hunting for meals.







How do chameleons change colour? p66 Why are paper cuts so painful? p67 If you hold in a fart, where does it go? p69

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PLUS! FOUR MINI POSTERS INSIDE

GET
READY
FOR...

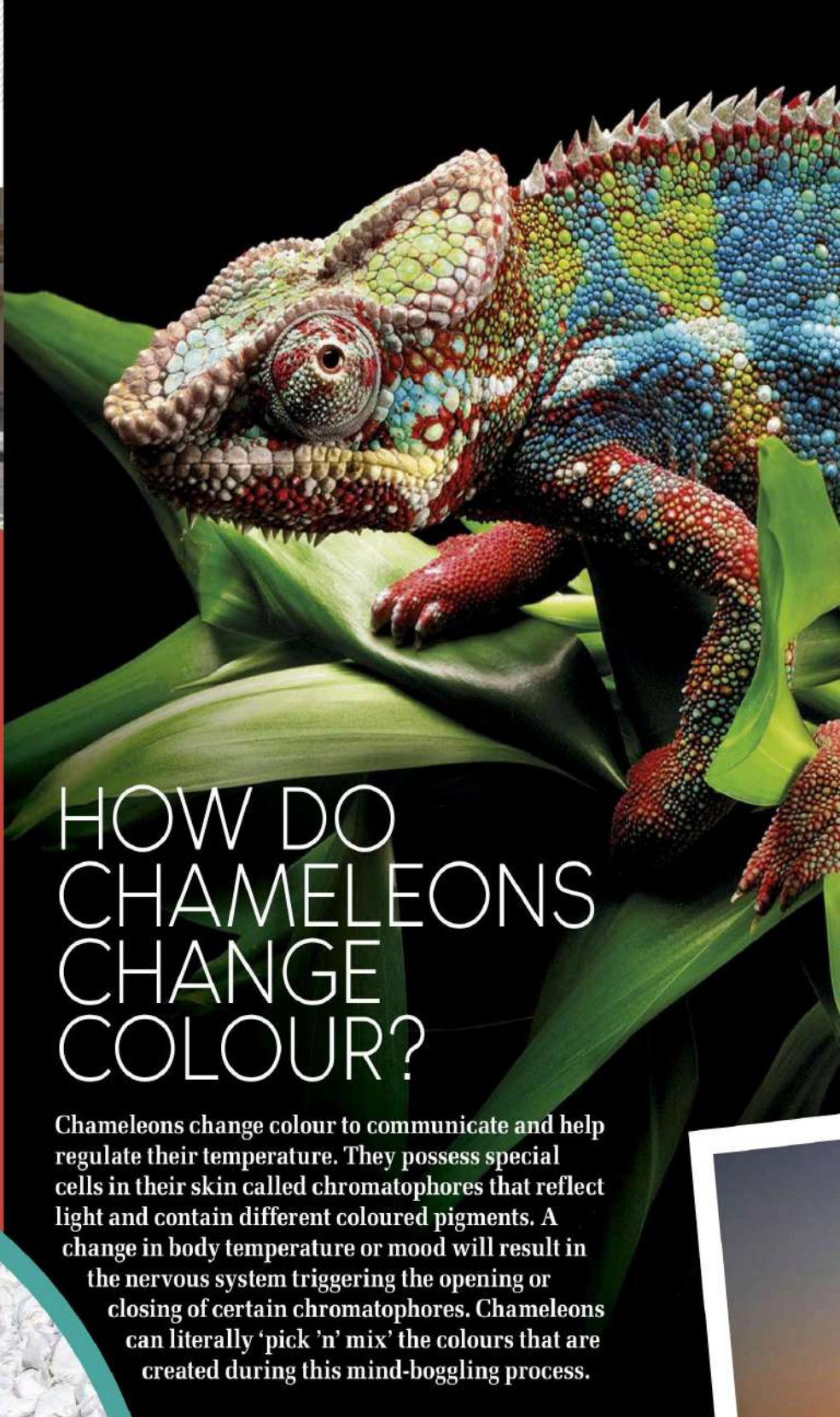
25
**BRAIN-BUSTING
PAGES**



WILL ELECTRIC CARS REDUCE POLLUTION?

Electric cars don't churn out fumes, so are an obvious choice for improving air quality in cities. But they are only as green as the electricity they run on. Most electricity is produced by burning fossil fuels like coal, gas and oil. So charging an electric car can indirectly generate greenhouse gases, particularly in countries that use lots of coal power. As we use more renewable energy like wind, solar and tidal power, electric cars will become more eco-friendly.

ALAMY, GETTY X4 ILLUSTRATION CHRIS PHILPOT



HOW DO CHAMELEONS CHANGE COLOUR?

Chameleons change colour to communicate and help regulate their temperature. They possess special cells in their skin called chromatophores that reflect light and contain different coloured pigments. A change in body temperature or mood will result in the nervous system triggering the opening or closing of certain chromatophores. Chameleons can literally 'pick 'n' mix' the colours that are created during this mind-boggling process.

How long until we run out of landfill space?

In the UK, estimates range from six to eight years. But local authorities have been saying this since 2010 and our landfill sites aren't full. This is because councils are recycling more waste. In 2009, 90 per cent of our rubbish went to landfill. It's less than 50 per cent now and forecast to drop to 10 per cent by 2020.

Panther chameleons like this one live in Madagascar. The males are larger and more colourful than the females



DID YOU KNOW?

It's not just chameleons that have chromatophores – other reptiles do too. So do fish, amphibians and squid.

Do elephants really never forget?

An elephant has a very large brain for its size and the region of the brain responsible for memory is more developed with a greater number of folds – this results in powerful abilities to recall important survival data such as where to find food and water over hundreds of kilometres, and who is a friend or enemy. The matriarch of a herd (who can live for 60 years) may recognise over 200 individual elephants and can react to the call of a deceased member of her herd two years after their death. So although they undoubtedly forget what they don't need to remember, they appear to remember what they cannot afford to forget!

WHY ARE PAPER CUTS SO PAINFUL?

At a microscopic level, paper is actually quite rough. A metal knife makes a clean straight cut, but paper acts like a saw blade and does a lot more damage to cells and nerve endings. Paper also leaves behind tiny fibres and chemical residues, which irritate the wound even more.

Could I be hit by falling space debris?

There are over 1,400 satellites in orbit, plus thousands of bits of space junk that might survive entry through our atmosphere. But the chances of being hit are low. Most of the Earth is covered by sea, and the majority of land is uninhabited. The European Space Agency puts the risk of being hit at less than a billion to one.

WHAT IS THIS?

Oozing lava

Here, lava from Hawaii's Kilauea volcano creeps across the countryside, destroying everything in its fiery path. The volcano has been erupting since 1985, but in early May this year an earthquake shook the land. Lava started to spew from cracks in the ground, including in areas with houses. More than 700 homes were destroyed. Finally, in mid-September, volcanic activity slowed.



If you hold in a fart, where does it go?

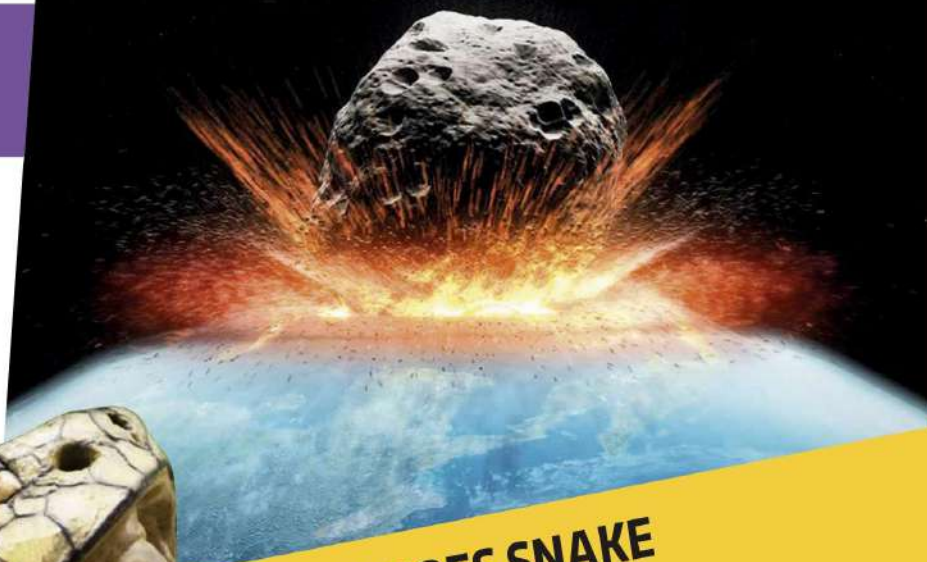
Fart gas mostly comes from the bacteria and yeasts that live in the large intestine. If you suppress a fart, it actually just seeps out more quietly, or you might be able to hang on until the next time you are on the toilet. But sooner or later, that fart is coming out!

SHUTTERSTOCK, GETTY, SCIENCE PHOTO LIBRARY



COULD AN ASTEROID KNOCK EARTH OUT OF ITS ORBIT?

No. The Earth has a lot of mass and moves extremely quickly in its orbit around the Sun; in science speak, we say its 'momentum' is large. To significantly change the Earth's orbit, you would have to impart a whopping change to the Earth's momentum by smashing into it really hard, and not even the biggest asteroids could manage that.



HOW DOES SNAKE VENOM KILL?

Snake venoms contain a cocktail of enzymes and proteins. Some stop nerves working, others interfere with the heart, some rot muscles or cause blood vessels to leak. Snakes can control how much venom they inject with a single bite and tend to use more than the lethal dose. If snake venom doesn't kill quickly enough, the prey may escape or injure the snake – that's why it has to be so deadly.



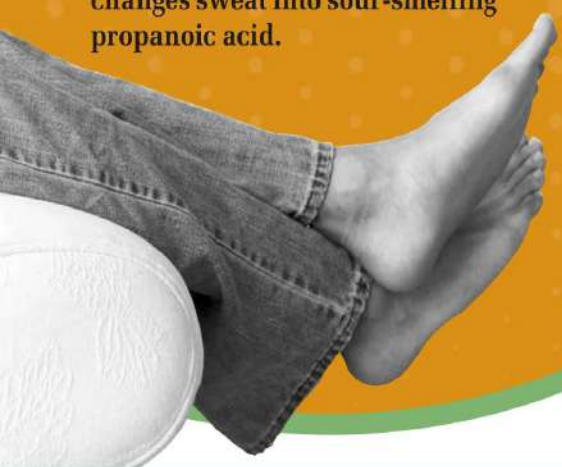
DID YOU KNOW

A black mamba injects up to 12 times the lethal dose for humans in each bite and may bite 12 times in an attack.



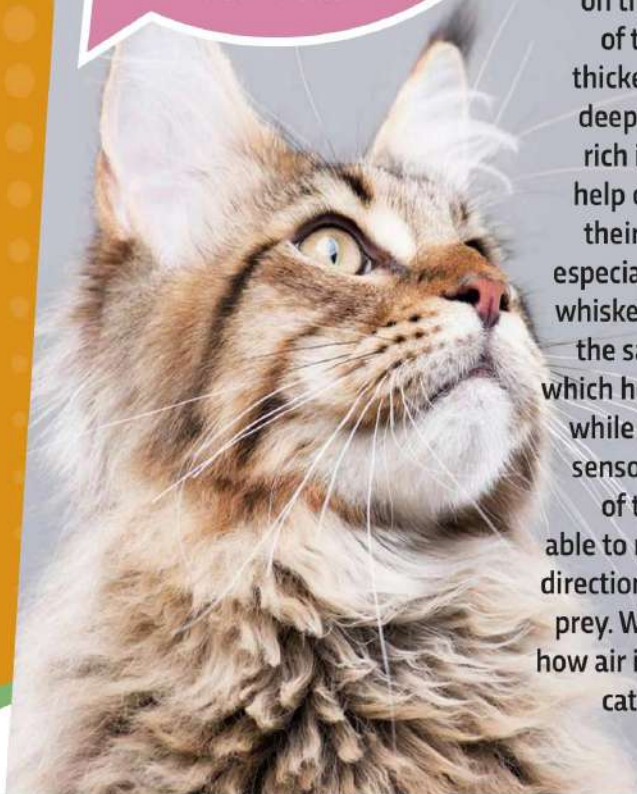
WHY DO SWEATY FEET SMELL OF CHEESE?

The same bacteria that is used to ripen many cheeses also lives on our skin and eats dead skin cells. It's called *Brevibacterium* and it gives off chemicals that smell cheesy. Another skin-munching bug is *Staphylococcus epidermidis*, which produces isovaleric acid that smells cheesy and vinegary. The final ingredient in this 'socktail' is *Propionibacterium*, which changes sweat into sour-smelling propanoic acid.



DID YOU KNOW?

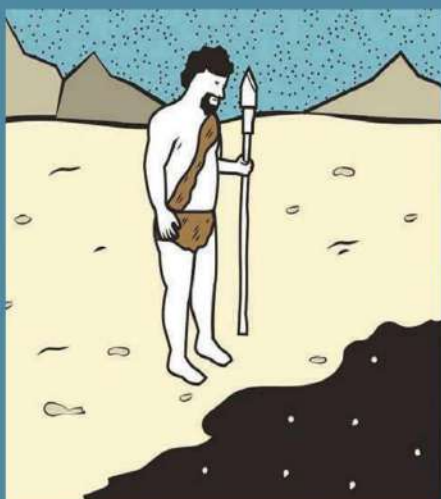
You should never cut a cat's whiskers. It will make them feel frightened and disorientated.



Why do cats have whiskers?

A cat's whiskers are located on its cheeks, above the eyes, on the chin and the backs of the front paws. These thickened hairs are rooted deeply in the skin and are rich in nerve endings that help our feline friends feel their way through a hunt, especially in the dark. Facial whiskers are approximately the same width as the cat, which helps it judge distance while on the move. Special sensory organs on the tips of the cat's whiskers are able to monitor the distance, direction and even texture of prey. Whiskers also monitor how air is moving around the cat to help it coordinate its movements.

HOW COULD I BECOME A FOSSIL?



1. PICK THE RIGHT PLACE TO DIE

Fossils form best in environments without much oxygen that keep out bacteria.

These conditions also encourage the chemical reactions that replace your body's soft tissues with hard minerals. Drowning in a stagnant lake is a good bet, or a cold sea.



2. GET BURIED QUICKLY

A layer of sediment will stop animals from nibbling you and protects your skeleton from being scattered by ocean currents. Shallow seas are good because a constant, gentle rain of dead plankton and sediment is washed down by rivers. It will take at least 10,000 years to fossilise you.



3. GET DISCOVERED

If you want to be found as a fossil, pick a place where the motion of the Earth's plates will lift you above sea level, so erosion can start peeling away the layers of rock above you. If the rock below you is crumbly, so much the better – it will collapse into cliffs and expose your fossil faster.

BBC
BIG BROTHER & MIND-BLOWING
ANSWERS



Storm surfer

In July 2016, Red Bull Air Force athlete Sean MacCormac skysurfed through a storm, plummeting at up to 209km/h (130mph). He eventually opened his parachute and touched down safely in Florida, three kilometres below.

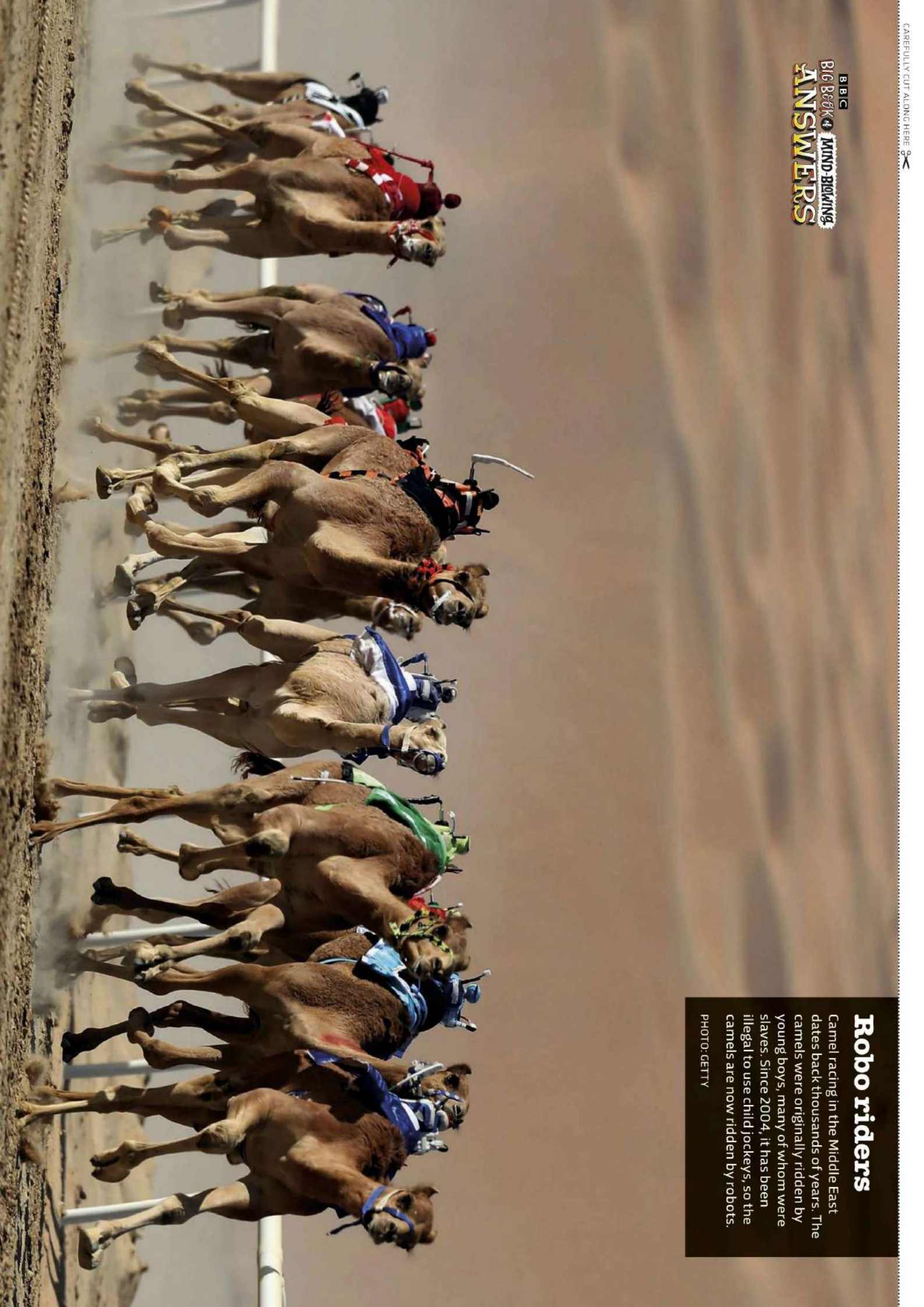
PHOTO: SEAN MACCORMAC

BBC
BIG BEEK & MIND-BLOWING
ANSWERS

Robo riders

Camel racing in the Middle East dates back thousands of years. The camels were originally ridden by young boys, many of whom were slaves. Since 2004, it has been illegal to use child jockeys, so the camels are now ridden by robots.

PHOTO: GETTY



Is it getting harder to hack computers?

Security is becoming more advanced, and computer systems are complicated, so it is difficult to attack a computer network. In this respect, hacking is more difficult compared to 20 years ago. However, there are more and more internet-enabled devices in the world, many of which run relatively simple software. Therefore, there are many opportunities to hack into smartwatches, websites, smartphones, games consoles and CCTV cameras.



DID YOU KNOW?

The spacesuit worn by Neil Armstrong for the 1969 Moon landing was made by a bra manufacturer.



Did the astronauts leave anything on the Moon?

The Apollo spacecraft, which took humans to the Moon, were designed to lift off from the lunar surface at a particular weight. Since the astronauts wanted to bring lots of Moon rock back home, they had to leave behind

unwanted items to save on weight. This discarded junk included, among other things, a couple of golf balls, 12 cameras, 12 pairs of boots, a gold-plated telescope and 96 bags of pee, poo and sick! On the Moon, there's no wind, pollution or water to erode, rust or dissolve all these items – although sunlight has probably bleached the flags left there.

COULD MY DOG CATCH MY COLD?

The viruses that cause ordinary colds are all quite specific to a certain species. Dogs can't catch human colds (or vice versa), but they do have their own version, called kennel cough. The flu virus is much more adaptable though. Bird, pig, horse, dog and human flu have all been shown to jump between species. And bacterial diseases are even more contagious. Cats and dogs can both catch tuberculosis from humans, for example.





IS IT POSSIBLE TO FOOL FINGERPRINT READERS?

It depends on the technology used in the fingerprint reader, but it is possible to trick many of them. Some will be fooled by a mould of your finger made out of the same jelly as gummy bears. Some will be deceived by a fingerprint on a piece of sticky tape. Some are even outfoxed by a photocopy of a fingerprint. Most are not even aware if the owner of the finger is alive or dead!



Why do dogs wag their tails?

Dogs communicate with their tails. The position of the tail can tell us a lot about how a dog is feeling; hung low suggests fear and submission, whereas held high is a sign of dominance and interest. The speed and direction of the wag is important in figuring if the dog is either stressed or uncertain (slow and to the left) or happy and relaxed (fast and to the right).

Why does the inside of a shell sound like the sea?

The sound has nothing to do with the sea, nor the shell's marine origins. It's all down to the air trapped inside the shell. As the air is unable to escape, it vibrates at frequencies dictated by the size and shape of the shell, creating a mix that sounds a bit like waves on shingle. You can create a similar effect just cupping your hand over your ear.



GETTY X4, NASA ILLUSTRATIONS: PETER SUCHESKI

WHAT HAPPENS IN MY BODY WHEN I BURP

BURP



1. EAT AND DRINK

With every mouthful of food or drink, you swallow a couple of millilitres of air. Fizzy drinks add another millilitre or so of carbon dioxide.



2. GASES SEPARATE

The gases separate from the food in your stomach and press against the lower oesophageal sphincter, which holds the top of the stomach closed.

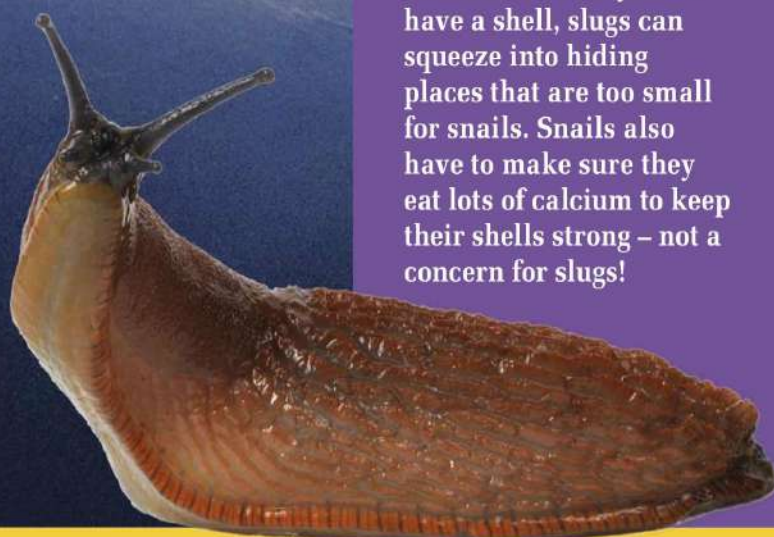


3. SPHINCTER OPENS

Eventually, the pressure forces the sphincter open and the air rushes out. The belching sound is caused by vibrations in the sphincter and oesophagus wall.

WHY DOESN'T EARTH'S ATMOSPHERE VANISH INTO SPACE?

The Earth's atmosphere is made up of lots of gas and vapour particles. Despite being too tiny for us to see, these particles still feel the gravitational pull of the Earth, and are therefore kept in place. They could escape from Earth's atmosphere if they had enough energy – for example, if the Earth was closer to the Sun, and thus hotter. Luckily, our planet is just the right distance from the Sun to avoid that.



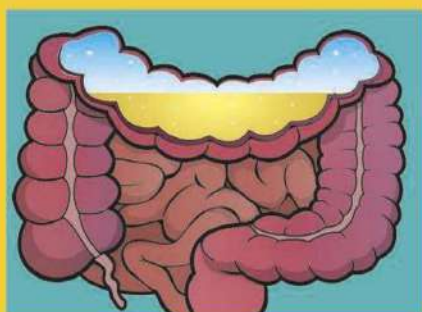
Why don't slugs have shells?

Slugs are not snails that have lost their shell, they are different animals. While slugs have no visible shell, some species may have a tiny shell, or one that is inside the body. It is believed that the first mollusc-like animals were shell-less, with small or internal shells emerging later, and external shells evolving after that. As they don't have a shell, slugs can squeeze into hiding places that are too small for snails. Snails also have to make sure they eat lots of calcium to keep their shells strong – not a concern for slugs!

AND FART?

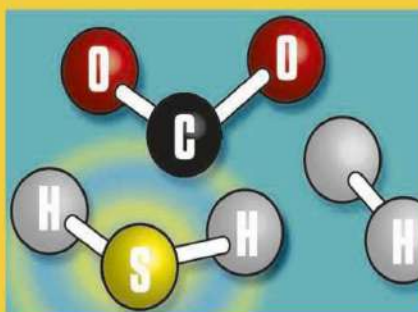
Everybody burps and farts around 2.5 litres of gas per day, which comes from the air we breathe, the drinks we guzzle, and the bacteria in our guts.

FART



1. BACTERIAL ACTION

A small amount of swallowed air makes it into the intestines, but most of the gas there is produced by the bacteria that help to digest our food.



2. STINKY SULPHUR

The gas is mainly hydrogen and carbon dioxide. The smell comes from sulphur compounds that are only present in tiny amounts.



3. FART OR POO?

The nerve endings in your bottom allow you to distinguish between a build-up of gas and a solid poo, so you can fart safely without worrying.

WHAT IS THIS?



Extreme insect

This leggy critter, measuring an impressive 62.4cm, is the longest insect in the world. It's so big that it would not fit on these two magazine pages! Dubbed *Phryganistria chinensis zhao*, the insect was discovered on a mountain in the Guangxi region in southern China by scientist Zhao Li. Li took it back to the Insect Museum of West China, where it laid six eggs. When the babies hatched, they measured 26cm.



WOULD A FIGHT HURT LESS IN MICROGRAVITY?

The first punch might hurt less, because the attacker can't stand firmly on the floor of the spacecraft. Some of the momentum of their fist will therefore be wasted pushing their body backwards. But once the two brawlers are pushed in opposite directions to the walls of their spacecraft, they will be able to launch themselves back again. The second punch will be boosted by the forward motion of the astronauts as they sail together, and it will hit even harder.



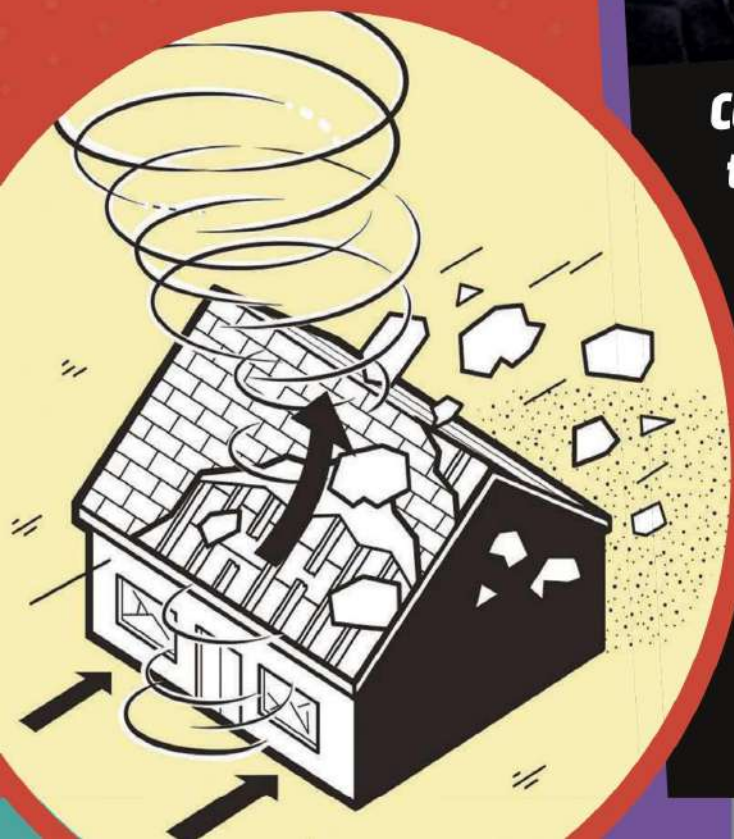
SCI SMARTS

The iris is the coloured part of your eye. Its patterns are unique to you. Even identical twins have different iris patterns.

How do tornadoes rip roofs off houses?

In the US, around one-third of tornadoes are strong enough to take the roofs off houses. They do this via a double-whammy effect: the fast-moving wind causes pressure over the roof to suddenly drop. Debris trapped in the vortex then smashes doors and windows. Air then rushes through these broken doors and windows, increasing the pressure under the roof. The resulting pressure difference then rips the roof off.

EYEVINE, GETTY, ILLUSTRATIONS: PHIL ELLIS



Can facial recognition software tell identical twins apart?

Identical twins are a good test for facial recognition systems. When Windows 10 launched, some wondered whether twins could fool Windows Hello, the unlocking system that uses facial and iris recognition. An Australian newspaper tested it with six pairs of identical twins, and the system did manage to tell the twins apart.

When it comes to identifying faces, humans are better at judging whether someone looks happy, sad, angry or just a bit shifty. But computers are better at measuring the size and shape of features on a face. Windows Hello is built on technology that combines a webcam, infrared camera and infrared laser projector. This three-pronged approach improves the system, even when confronted with identical twins.

WHY DON'T WE EVER SEE VIDEOS FROM MARS?

Video requires much higher data transmission rates than photographs, and it currently takes several hours for NASA to receive just one high-resolution colour photo from Mars. Engineers are looking at using infrared technology that can offer far higher data rates. The next generation of Mars landers may then be able to send back HD video from the Red Planet.

Do insects sleep?

Yes, but they don't have eyelids, so they don't close their eyes like we do. Cockroaches, however, will fold down their antennae when they sleep, which helps protect their delicate sensory organs.

Lack of sleep seems to have a similar effect on insects as it does on humans. Experiments have shown that when fruit flies are forced to stay awake, they are slower at learning their way around simple mazes than fruit flies that are allowed plenty of sleep.

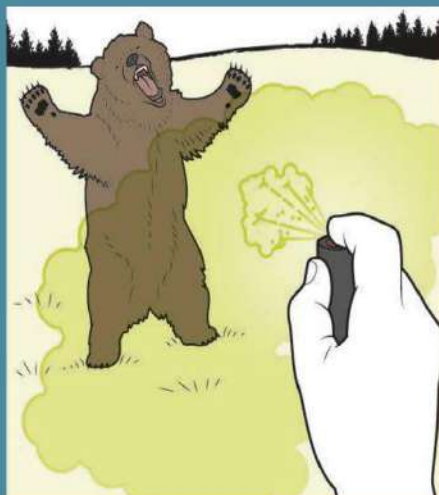


HOW CAN I SURVIVE A BEAR ATTACK?



1. DON'T RUN

Black, brown and polar bears can outrun you, and fleeing will trigger the bear's predatory instincts that make an attack more likely. Climbing a tree might help against a brown bear, but black bears are excellent climbers. Standing still or backing away slowly are better tactics, even if the bear is charging.



2. DON'T SHOOT

A bullet won't kill a charging bear before it reaches you. Pepper spray is more effective. The idea is to spray a wall of mist between you and the bear, while the bear is still 10 to 15 metres away. This doesn't require accurate aim and will often deter the bear instead of just enraging it.



3. DON'T PANIC

Black bears can sometimes be fought off, especially if you hit their nose or eyes. With brown bears, play dead. Keep your rucksack on, interlock your fingers around the back of your neck and curl up on the floor. Stay there for at least half an hour. The bear will often wait to see if you are really dead.

WHAT ARE SUPERFOODS?

A so-called 'superfood' has no scientific definition. Fruits and vegetables with lots of antioxidants, like blueberries and kiwi fruit, often top the superfood list. There are claims that antioxidants can fight harmful substances in your body, but some studies suggest that digestion destroys much of the antioxidant power. However, the foods listed as superfoods are all healthy and will enrich a balanced diet.



HOW DO SHARKS SMELL BLOOD UNDERWATER?

When you smell something in the air, it's because scent molecules have dissolved into the wet lining of your nose. Smelling underwater is no different, except that the molecules are already dissolved in the water. It's a myth that sharks can smell a single drop of blood from a mile away. Sharks actually have roughly the same sensitivity as other fish and can detect smells at between one part per 25 million and one part per 10 billion, depending on the chemical and the species of shark. At the top end, that's about one drop of blood in a small swimming pool.



Why do leaves change colour in autumn?

Deciduous trees drop their leaves to reduce water loss during winter, when it is too cold to grow. But rather than just discard the entire leaf, the tree recycles as much of it as possible. The green chlorophyll from the leaves is the first to be broken down and reabsorbed, which allows yellow carotenoids and red anthocyanin to show through.



DID YOU KNOW?

The smallest species of shark is the dwarf lantern shark. It is just 20cm long and has only been found off the north coast of South America.





HOW FAR DO COUGHS AND SNEEZES TRAVEL?

It's horrible when someone standing next to us coughs all over us, as we know it could make us ill. But according to research by scientists at the Massachusetts Institute of Technology, it's not just the person next to us we should worry about: coughing spreads droplets as far as six metres and sneezing as much as eight metres. These droplets hang in the air for up to 10 minutes!



SCI SMARTS

Scientists think that for life to exist, a planet or moon needs to have water.

In our Solar System, possible candidates are Mars, Saturn's moon Enceladus, and Jupiter's moon Europa.

Could we seed life on another planet?

Quite possibly – and scientists try to prevent it from happening during missions into space. Space probes are treated with heat, radiation and disinfectants before launch, to ensure that no Earth-based organisms end up in space.

More recently, in 2017, NASA brought its Cassini mission to an end by steering the probe into Saturn's atmosphere, where it would safely burn up. They didn't want it to accidentally crash into the icy moon Enceladus, which could potentially support life.

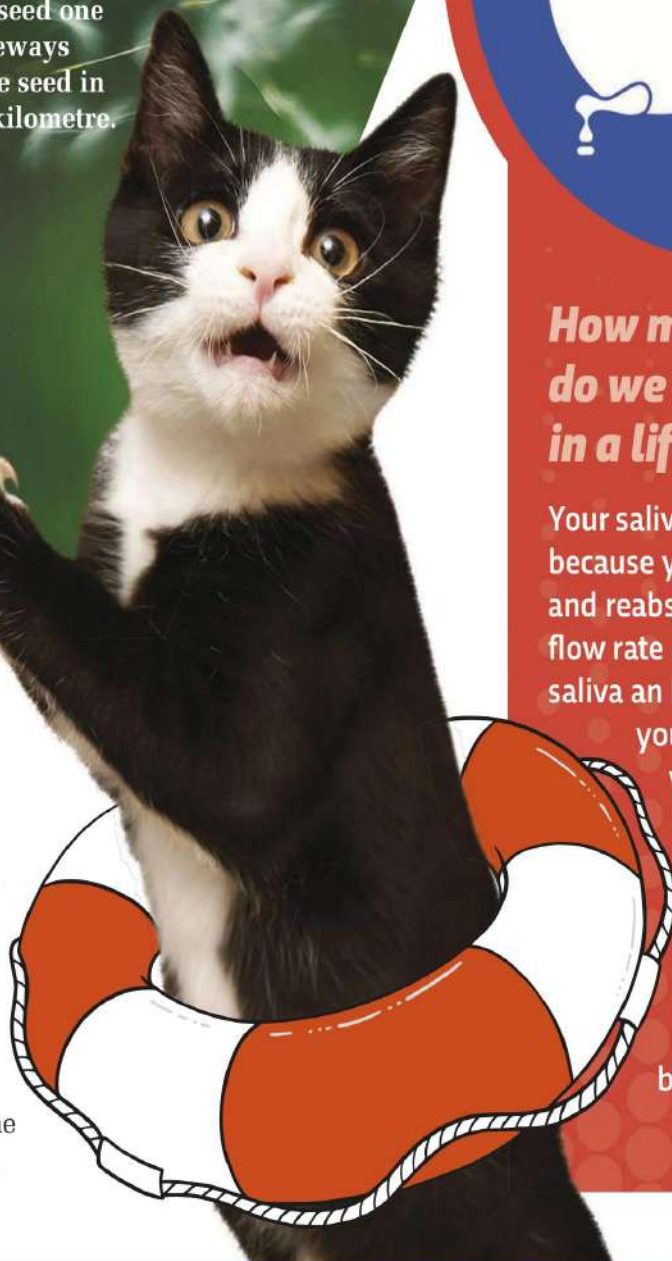
How far can dandelion seeds travel?

About 99.5 per cent of dandelion seeds land within 10 metres of their parent plant. That's because the seed 'parachute' falls at about 30cm per second and dandelions only grow about 30cm high. So that gives each seed one second of flight time to be blown sideways by the wind to its new home. Just one seed in every 7,000 will travel more than a kilometre.

ALAMY, GETTY X2, SCIENCE PHOTO LIBRARY

WHY DO CATS HATE WATER?

Cats groom themselves with regular licking, and this stops skin oils from building up on their fur. As a result a cat's coat is fluffier and less waterproof than a dog's, so they get colder and their fur feels heavier if they get wet. But not all cat breeds hate water – the Turkish Van and Bengal both like swimming.



How much saliva do we produce in a lifetime?

Your saliva is mostly recycled, because you keep swallowing and reabsorbing it. But the flow rate is around 30ml of saliva an hour – more when you're eating, less when you're sleeping.

That's a wine bottle full every day, or 20,000 litres in your lifetime. In other words, 53 bathtubs full to the brim with saliva!



HOW FAST DOES RAIN FALL?

The maximum speed of a raindrop depends on its size. The droplets in a light rain shower measure about 2mm across and fall at about 6.5 metres per second or about 22.5km/h (14mph). The largest possible raindrops are 5mm across and hit the ground at 32km/h (20mph).

22.5km/h
(14mph)

2mm

32km/h
(20mph)

5mm



How do squirrels find the nuts they buried?

It was once thought that they just used their noses to sniff out buried nuts and that most of the nuts were never actually found. But squirrels actually have a good memory and can build a map of the route from one hidden nut to the next. They still use smell to find the stashes of other squirrels, but they find a lot more of their own by memory.



DID YOU KNOW?

Research suggests that eating raw apple or mint leaves straight after garlicky food can reduce smelly breath.



WHY DOES GARLIC MAKE YOUR BREATH STINK?

When raw garlic is chopped, it produces lots of chemicals, most of them stinky. When you eat the garlic, most of these chemicals are broken down in your stomach and liver, but one of them, called 'allyl methyl sulphide' survives and is absorbed into the blood. This means that it can travel through your lungs and into your breath for up to two days.

WHY CAN'T PENGUINS FLY?

Even the very smallest penguin, the fairy penguin, weighs 1kg, which is about as much as a herring gull. But herring gulls have a 140cm wingspan, compared with a much shorter 32cm for the fairy penguin. Around 62 million years ago, penguins began evolving adaptations for swimming underwater rather than flying through the air. Their bones are filled with heavy bone marrow rather than air and they have much larger stomachs for undergoing long fishing trips away from the nest.



Why are bald heads so shiny?

Most of the skin on your body is actually covered with tiny hairs called vellus hairs that give your skin a slightly velvety, peach-fuzz look. When men go bald, the hair follicles shrink and turn into skin cells, so there are no hairs at all – not even vellus hairs.

But the scalp is particularly shiny because of sebaceous glands. These glands release oil and are found all over our skin, but the scalp has a lot more of them. As bald heads have no hair to absorb the oil, it coats the skin instead and makes it look shiny. What's more, studies suggest that more active sebaceous glands could actually play a role in early hair loss.





Horn-tastic!

No, it's not a tiny *Triceratops*, it's a Jackson's chameleon. They are native to Kenya and Tanzania, where they feed on creepy-crawlies. The males use their horns to fight each other for a female.

PHOTO: GETTY

Mega mech

Say hello to Method-2. This mech is four metres tall and it is controlled by a person who sits in the cockpit. It's hoped that it could be used to help us explore dangerous environments.

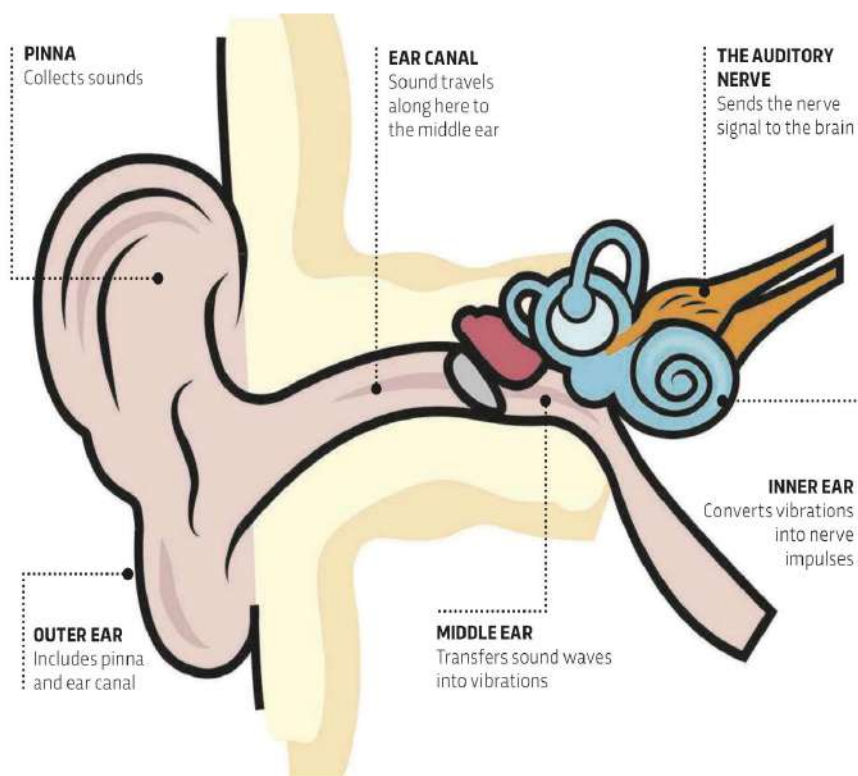
PHOTO: GETTY



Why do we see shapes and colours when we rub our eyes?

These shapes and colours, called 'phosphenes', were reported as long ago as the time of the Ancient Greeks. Rubbing your eyes increases the pressure within the eyeball and this pressure excites cells in the retina in the same way as light does. Your brain doesn't know the difference, and so interprets it as though you are seeing light from the world outside.

GETTY X2 ILLUSTRATION: PHIL ELLIS



DOES THE SHAPE OF MY EARS AFFECT MY HEARING?

Yes. The outer part of your ear, called the pinna, is shaped to collect sounds and locate their source. Try listening to a steady sound while moving your head or bending your ears. The changes you notice are what your brain uses to pinpoint the sound's location, and the

pinna's shape exaggerates these variations. In experiments, people wearing false ears have trouble locating sounds for up to six weeks but they don't lose the ability to hear without them. So it is a bit like learning a new language.



SCI SMARTS

The retina is at the back of the eyeball on the inside. It converts light into signals to send to the brain.

ARE THERE ANY VEGETARIAN SPIDERS?

Just one. Out of around 40,000 spider species, *Bagheera kiplingi* is the only spider known to have a herbivorous diet. It lives in Mexico and Costa Rica, and feeds mostly on blobs of proteins called 'Beltian bodies' that are found on acacia trees. But even this spider sometimes eats ant larvae, so perhaps it is closer to the sort of vegetarian that still eats prawns!



Bagheera kiplingi eating a yummy lump of protein from an acacia tree



CAN COMPUTERS LEARN LIKE HUMANS?

To make computers learn, we use programs that work the same way as brain cells. These programs are trained with data until they can spot patterns or make predictions about what might come next. But humans are better – we can learn complex concepts and different ideas. We still don't fully understand how brains work, so computers are unlikely to be as good at learning as humans for hundreds of years.



How can I tell if a rock fell from space?

Grab a magnet. Most meteorites are rich in iron so they'll stick to magnets. Next, see if the rock's surface is burnt or melted from its passage through the atmosphere. Yes to both of these? Ask a laboratory to test it for nickel content. Virtually all meteorites contain high amounts of nickel, which is fairly rare on Earth.



SCI SMARTS

A meteorite is a space rock that lands on Earth. If it burns up in our atmosphere instead, it is called a meteor.


TOP 10

LONGEST LASTING LANDFILL ITEMS

- 1 Glass bottles**
Time to break down: one million years
- 2 Disposable nappies**
Time to break down: 450 years
- 3 Plastic bottles**
Time to break down: 450 years
- 4 Plastic bags**
Time to break down: 200-500 years
- 5 Aluminium cans**
Time to break down: 80-200 years
- 6 Rubber-soled shoes**
Time to break down: 50-80 years
- 7 Tin cans**
Time to break down: 50 years
- 8 Clothing**
Time to break down: up to 40 years
- 9 Plastic film***
Time to break down: 20-30 years
- 10 Paper coffee cups**
Time to break down: 20 years

*clingfilm, magazine wrappers, crisp packets, etc



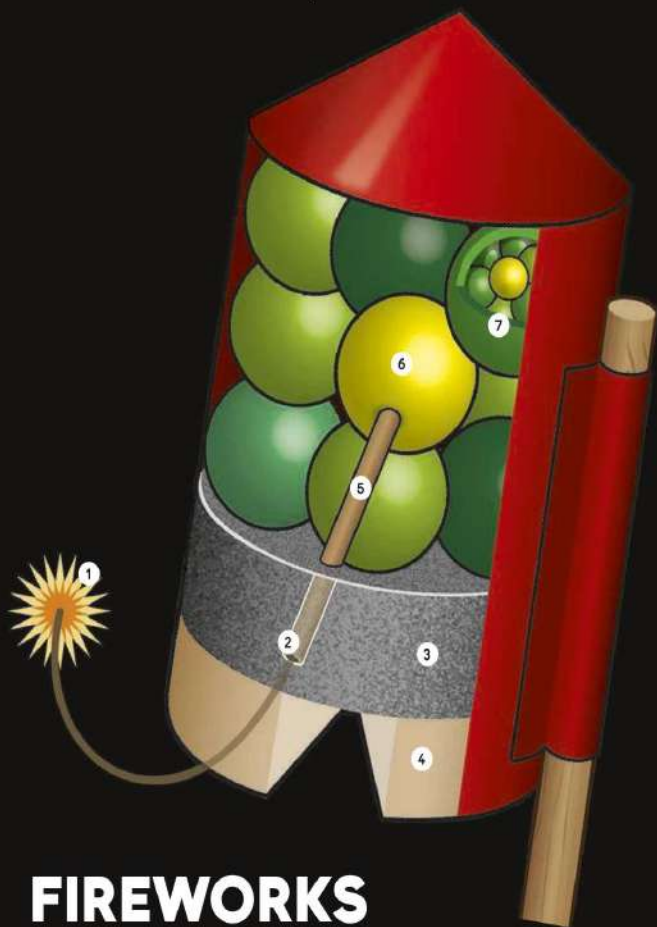


Sperm whales don't just have one of the longest intestines, they also have the largest brain of any animal

HOW LONG IS THE LARGEST ANIMAL INTESTINE?

It's a fairly close contest between the sperm whale and the blue whale. A large sperm whale's intestine may be more than 150m long, and a blue whale's may be up to 220m. While this sounds enormous, it's actually only seven or eight times the whale's body length. In contrast, a cow has intestines that are 20 times as long as its body – that's 40m for a 2m-long cow!

HOW IT WORKS



FIREWORKS

In November, the skies are full of sound and colour. Lots of people like rockets best, like the one shown here. Rockets are packed with exploding shells, known as 'stars', that are launched into the air using gunpowder.

1 ELECTRICAL IGNITER

Fireworks at displays are often synchronised with music. The fireworks are triggered via signals sent through electrical cables, which in turn trigger an igniter charge.

2 IGNITER CHARGE

This consists of a small electrical heating device made from wire that glows hot enough to ignite a mixture of magnesium powder and potassium nitrate, triggering both the lift charge and the timed fuse.

3 LIFT CHARGE

A large part of the rocket's mass is the lift charge that provides the upward thrust. The lift charge is made from gunpowder, which contains sulphur, charcoal and potassium nitrate. Commercial firework displays sometimes use gunpowder that does not contain sulphur, to reduce the amount of smoke.

4 CLAY NOZZLE

A plug at the bottom of the firework

has a specially shaped hole that directs the gases produced by the lift charge to create thrust.

5 TIMED FUSE

This hollow wooden tube is packed with gunpowder. It is designed to burn through just as the firework reaches the top of its arc, setting off the main display burst.

6 SCATTER CHARGE

Another load of gunpowder is stuffed into a cardboard or plastic sphere in the centre of the firework. When the fuse reaches it, the explosion ruptures the firework's outer casing and flings the surrounding 'star' charges in all directions.

7 STAR CHARGES

These are pellets of different metals that burn to produce the colours and effects we see in the sky. For example, copper gives green patterns and strontium is used for red. The star charges may have their own smaller starbursts, fountains or pinwheels inside.

Could our brains be fooled by virtual reality?

VR can trick the brain in all sorts of ways. In fact, one problem with VR is that it confuses our brains *too* well. The game you're playing might make you think you're flying in plane, for example, but your balance system located in your ear says you're sitting still. This means that many players end up feeling travel sick.



DID YOU KNOW?

On the International Space Station, urine can be filtered to make drinking water.

WHY CAN'T ALL PLASTICS BE EASILY RECYCLED?

When heated, most plastics either get softer or harder. The ones that get soft can be shaped into any form you like, which also makes them easy to recycle. For example, milk containers can be melted and turned into furniture, plastic water bottles become fleece jackets, and bottle tops can get a new lease of life as storage boxes. Plastics that get harder when you heat them are almost impossible to recycle as they cannot be melted and reformed into new items.





WHY WERE DINOSAURS SO BIG?

When the dinosaurs lived, the climate was warmer, with higher carbon dioxide levels. This produced lots of plants, and herbivorous dinos may have grown big partly because there was enough food to support them. But being large also helps to protect against predators like *T. rex*. Meanwhile, carnivores were becoming larger just so they could tackle their enormous prey.

How do astronauts go to the loo?

For 'number ones', they use a funnel attached to a hose that is connected to a fan that sucks the pee away. For 'number twos', they position themselves carefully over a hole about the size of a drainpipe and clamp their feet into foot straps. Waste is caught in a bag, which they seal after use and the package is sucked into a collection drum.



The toilet on the International Space Station. The yellow funnel is where astronauts pee

What are supercomputers used for?

The best supercomputers fill rooms, cost millions and are thousands of times faster than your home computer. They are usually used for complex scientific problems involving lots of maths. Some are used to test the strength of computer security methods. They have also been used to find out how swine flu spreads, to predict climate change, and even to understand the Big Bang at the beginning of the Universe.





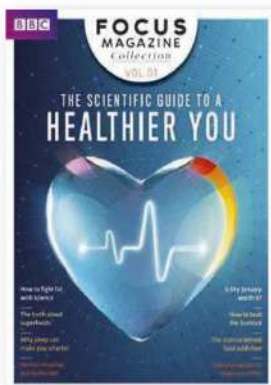
WHAT IS THIS?

Rocket engine

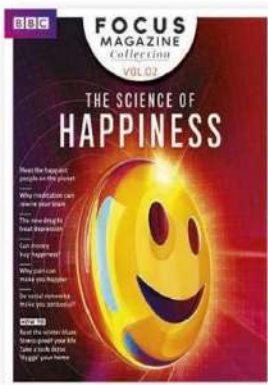
This is a close-up of the engine and exhaust pipes of the Saturn V rocket. The rocket was built by NASA in order to blast astronauts to the Moon for the Apollo missions. The rocket was enormous, with a height of 111 metres.

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behind what really
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fitter, as experts reveal
how to eat, exercise
and sleep well.



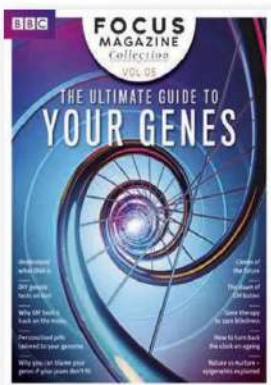
Discover the science
behind how to be happy,
from stress-busting tricks
to taking a tech detox.
And find out why the
happiest people on the
planet keep smiling.



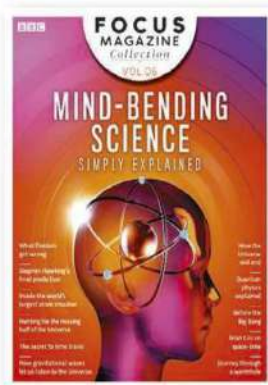
From the depths of the
ocean to outer space,
this special issue joins
the expeditions that are
pushing the boundaries
on our quest to reach the
final frontiers.



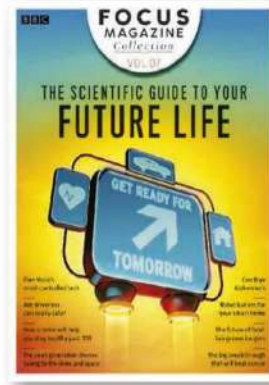
Find out how we can fix
climate change, beat mass
extinction and protect
the planet. Experts reveal
solutions to overfishing,
plastic waste, flooding
and air pollution.



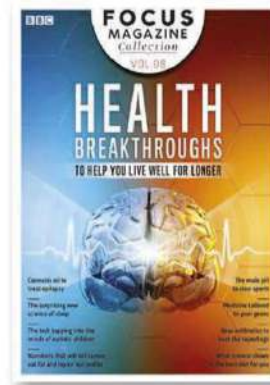
Each life form on this
planet has a unique
genetic code – DNA. Now
geneticists are using DNA
to improve our health,
eliminate hunger and
even bring back animals...



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space-time, black holes,
multiverses... The nature
of the Universe can make
your head spin. But this
special edition can help
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WHAT'S IT LIKE TO BE A... CAVE SCIENTIST?

Some scientists have seriously cool jobs!

Dr Hazel Barton is one of them...

WHAT DO YOU DO?

I'm a cave microbiologist, and I look for microbes that could help us make antibiotics and other drugs. We are also looking at making paint that can heal itself if it cracks, taking inspiration from how stalagmites and stalactites join up.

HOW DID YOU GET INTO THAT?

I grew up in Bristol. The Mendip caves are near there, and I started caving when I was in comprehensive school. I was terrible at outdoor sport but I loved caves and caving. At school, in our first microbiology lesson, we were asked to go and find microbes. I brushed my hair onto a Petri dish to see what would happen. And then the next day this disgusting thing grew on it. This got me interested in microbiology, and I learned that microorganisms transform the world around us. When I was at university a famous scientist who was also a caver encouraged me to combine the two.

THESE CAVE ENVIRONMENTS ARE WEIRD. COULD THEY OFFER CLUES ABOUT LIFE ON OTHER PLANETS?

Caves can help us find out how life evolved on our own planet, but could also help us find out about life in space. There is a cave in the Amazon – you have

to hack your way in with a machete to find it. You've got loads of clothes on because of the killer bees, and have to be careful of all these bugs and snakes that can kill you. But you finally reach the cave and it's two billion years old and made of iron. Yet there are microbes there eating into the rock. Mars has a lot of iron, so this cave might offer clues about life on the Red Planet.

YOU SOMETIMES SPEND DAYS UNDERGROUND. WHAT IS IT LIKE TO SLEEP IN A CAVE?

I'm used to it now! I have my sleeping bag and my pillow, and my whole setup. You do notice the lack of sunshine and you start to get a bit cranky after three or four days, but it's because your brain needs the daylight. I take blue fairy lights into the cave and put them up behind my camp, and that helps. There's nowhere to go to the toilet, so you have to do number twos in a bag and number ones in a bottle. And you can't wash your hands as there's nowhere for the dirty water to go. We use wet wipes and hand sanitiser. That's what upsets people the most – the lack of hygiene.

HAVE YOU SEEN ANY COOL CREATURES IN THE CAVES?

Where we go, deep underground, you don't see them as there is no food or light. At the entrance though, we will see lots of animals. In Mexico and Brazil, there are loads of creepy crawlies, and in



China there is this thing we call the 'Hairy Mary'. It is a really big centipede and it has super long legs that stick out. It's attracted to heat, so you'll be standing next to a rock and it will creep up behind you. They're so horrible and they look really hairy, but it's just their legs.


DO YOU EVER GET SCARED?

Yes – if you're not scared then you're not doing it right. In New Zealand, I had a rock the size of a horse fall when I was on top of it. I tried to jump free but I didn't get out of the way fast enough and I got my arm crushed. I had to spend three days in hospital, which was pretty frightening. We do scary stuff all the time – we'll come to the top of a 60m-deep pit that's never been explored before, and we have to tie a rope and go down it for the very first time.

HOW CAN YOUNG PEOPLE GET INTO CAVING?

I'd recommend joining a caving club – there are lots of them in the UK. Once you join, they'll start taking you to easy caves and teaching you how to do it safely. You can borrow equipment from them, like ropes and ladders, so you don't have to buy them. You can also do caving through Scouts or Girl Guides. We struggle to get young people excited about caving, but it's fun. You get to splash around in the mud and you end up filthy head to toe. Just do it one time, and you'll know straight away if you love it or hate it.

WHAT ADVICE DO YOU HAVE FOR PEOPLE WHO ARE INTERESTED IN A SCIENCE CAREER?

When you're thinking about a job in science, you need to think about what you *want to do*, rather than what you *want to be*. I have friends who wanted to be dentists, but then they realised you spend your whole day with your hands in someone else's mouth! If you follow things that you're interested in and love doing, then it can take you in new directions. 

"Caving is fun. You get to splash around in the mud and you end up filthy head to toe"

For more information on caving for beginners, visit newtocaving.com





GET SET

Stuff to keep you busy this autumn

OUT & ABOUT

Get your trainers on and go!

WILDLIFE PHOTOGRAPHER OF THE YEAR 2018

NATURAL HISTORY MUSEUM, LONDON,
19 OCTOBER 2018 – SUMMER 2019

www.nhm.ac.uk/visit/wpy.html

The Wildlife Photographer of the Year competition has been running for 54 years, and each time it features incredible photos of animals and the environment. Visit the Natural History Museum in London for a chance to see this year's entries. The image pictured here was snapped by Adam Hakim Hogg, winning him a prize in the 11-14 age category. It shows a horned tree lizard that was having a life-or-death fight with a centipede. The lizard won... then scooped the centipede. Ouch.

MANCHESTER SCIENCE FESTIVAL

VARIOUS LOCATIONS, MANCHESTER
18-28 OCTOBER

www.manchestersciencefestival.com

There's loads of science stuff going on in Manchester this October. You can go to the Ugly Animals Roadshow and marvel at some creepy critters, create an origami frog and then make it jump with static electricity, do experiments in the Wacky Science Lab, and find out how fish poo can save the world.

HALLOWEEN SPOOKTACULAR

GLASGOW SCIENCE CENTRE, GLASGOW
26 OCTOBER

www.glasgowsciencecentre.org

Visit the Glasgow Science Centre for an evening of spooky activities. There will be a Frankenstein autopsy, a cauldron full of gunge, a planetarium show,



Adam Hakim Hogg scooped a prize for this pic. Can you spot the centipede at the lizard's feet?

costume competitions, and the chance to escape a zombie apocalypse.

THE IMPOSSIBLE GARDEN

UNIVERSITY OF BRISTOL BOTANIC GARDEN, BRISTOL
UNTIL 25 NOVEMBER

www.bristol.ac.uk/botanic-garden

The Impossible Garden in Bristol features a selection of weird, experimental sculptures that will make your head spin! There are optical illusions, strange reflections and the biggest picnic bench we've ever seen.



GAME ON *Can you solve the mystery?*



TOTAL DARKNESS

totaldarkness.sciencemuseum.org.uk
FREE

The power's gone out in your town. There's no Wi-Fi, there's no telly, and you can't finish cooking your microwave popcorn. What do you do? Get out there and investigate, of course! In *Total Darkness*, you have to navigate dark streets, form theories and solve problems – all before your torch runs out of battery. Your choices score points for creativity, curiosity and communication. At the end of the game, you'll learn your 'science style' and find out how you can put your skills into action in real life.



GO STARGAZING

Wrap up warm and stare at the night sky

ORIONID METEOR SHOWER

21-22 October

This meteor shower will peak on 21 and 22 October, producing around 20 meteors per hour.

It is caused by dust from Halley's Comet.

HUNTER'S MOON

24 October

The October full Moon might be named after Herne the Hunter, who in English folklore led Yell Hounds

across the early winter sky. Another theory is that the Moon is now higher in the sky when full, giving more light for hunters to stalk their prey.

LEONIDS METEOR SHOWER

17-18 November

Some years, the Leonids meteor shower is one of the most dazzling, producing up to 1,000 meteors per hour. It won't reach those levels this time, but you'll still see loads of meteors if you look.

BOOK BONANZA

Brush up on your science smarts with these new reads



SO YOU THINK YOU KNOW ABOUT... VELOCIRAPTOR?

BEN GARROD

£6.99, ZEPHYR

This pocket-sized book is the latest in Ben Garrod's series about dinosaurs. He combines up-to-date science and a great sense of humour to reveal more about our favourite dinos from *Jurassic World*. Plus, we dig the cute cartoons and the quizzes to test your knowledge.



ABSOLUTELY EVERYTHING

CHRISTOPHER LLOYD

£17, WHAT ON EARTH

This book takes you on a rollercoaster journey through history, starting with the beginning of the Universe, before taking in Earth's history, dinosaurs, wars, robots and more. Just keep it hidden, as we reckon your mum or dad might want it too...



THIS BOOK IS NOT RUBBISH

ISABEL THOMAS

£6.99, WREN & ROOK

We all know that the grown-ups have messed up and now our planet is struggling. But you can help save it. This book contains 50 everyday ideas, like how to use less water when you do the washing-up, to how to make your next birthday party eco-friendly.

THE MEGA QUIZ!

Grab a pen and challenge your mates...

1 What does NASA stand for?

- ☐ a North American Space Agency
- ☐ b National Aeronautics and Space Administration
- ☐ c National Agency for Space Analysis

2 A rhino's horn is made from the same stuff as...?

- ☐ a Bone
- ☐ b Teeth
- ☐ c Hair



3 How many hearts does an octopus have?

- ☐ a One
- ☐ b Three
- ☐ c Eight

4 Which of these planets does not have rings?

- ☐ a Saturn
- ☐ b Venus
- ☐ c Uranus

5 What animal lives in a sett?

- ☐ a Badger
- ☐ b Fox
- ☐ c Hare

6 What is another name for your voicebox?

- ☐ a Larynx
- ☐ b Sarynx
- ☐ c Varynx

7 Which animal kills the most people per year?

- ☐ a Great white shark
- ☐ b Mosquito
- ☐ c Hippo

8 The Great Red Spot is found on which planet?

- ☐ a Mars
- ☐ b Saturn
- ☐ c Jupiter

9 Where is the smallest bone in your body?

- ☐ a Ear
- ☐ b Little toe
- ☐ c Neck



10 Which tree produces conkers?

- ☐ a Oak
- ☐ b Crab apple
- ☐ c Horse chestnut

11 Where would you find your retinas?

- ☐ a Ears
- ☐ b Lungs
- ☐ c Eyes

12 Which one of these is not a fossil fuel?

- ☐ a Coal
- ☐ b Geothermal
- ☐ c Natural gas

13 Who created the famous equation $E=mc^2$?

- ☐ a Albert Einstein
- ☐ b Stephen Hawking
- ☐ c Marie Curie

14 Which of these will not be attracted to a magnet?

- ☐ a A pure gold ring
- ☐ b An iron nail
- ☐ c A paperclip





**Tot up how many
you got correct...**

0-8

You're a caterpillar!

You've got potential to be incredible, but you could do some swotting up. Start munching through some facts!

9-16

You're a pupa!

You've got loads of cool knowledge and you're just waiting to burst out and wow everyone. Keep it up!

17-24

You're a butterfly!

You are super impressive and your knowledge cannot be beaten. Now why not see how well your friends and family do?

15 What is the most common blood type in the UK?

- ☐ a A
- ☐ b B
- ☐ c O

16 How many bones are there in an adult human body?

- ☐ a 206
- ☐ b 285
- ☐ c 170

17 What is the most abundant gas in the air we breathe?

- ☐ a Oxygen
- ☐ b Nitrogen
- ☐ c Carbon dioxide

18 According to legend, which famous scientist had an apple fall on his head?

- ☐ a Galileo Galilei
- ☐ b Charles Darwin
- ☐ c Isaac Newton

19 Which of these chocolate bars is also the name of the galaxy in which we live?

- ☐ a Milkybar

- ☐ b Aero
- ☐ c Milky Way

20 What does a camel store in its hump?

- ☐ a Water
- ☐ b Fat
- ☐ c Sugar

21 Which is the biggest?

- ☐ a *Tyrannosaurus rex*
- ☐ b Woolly mammoth
- ☐ c Blue whale

22 Which is the most acidic?

- ☐ a Bleach
- ☐ b Lemon juice
- ☐ c Coffee

23 What is another name for a tidal wave?

- ☐ a Tsunami
- ☐ b Cyclone
- ☐ c Sirocco

24 Which is the only bird with nostrils at the tip of its beak?

- ☐ a Ostrich
- ☐ b Penguin
- ☐ c Kiwi

GETTY X5

8. c
7. b
6. a
5. a
4. b
3. b
2. c
1. b
16. a
15. c
14. a
13. a
12. b
11. c
10. c
9. a
24. c
23. a
22. b
21. c
20. b
19. c
18. c
17. b

ANSWERS



BRAIN GYM

Give your grey matter a workout

WORDSEARCH

Can you find all 15 words in the grid?

CODING

DNA

GENIUS

MICROBE

SPACECRAFT

DATA

ENVIRONMENT

GRAVITY

PLASTIC

SUN

DINOSAUR

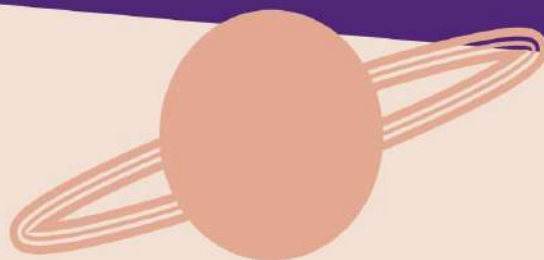
EXPERIMENT

MARS

ROBOT

TELESCOPE

I K N M I O R G M U T Y T S F
G D A T A H T S U I N E G U P
T N E M N O R I V N E M D N H
N H I I D G O E R P M I M U F
X E T D L Y G D O V I C O A S
T Y B A O R I C L S R R Z W O
F F D P A C S W Q E E O T X Z
D H A V L E I J C X P B O A W
B N I R L A N U A J X E B R M
R T A E C K S V J J E O O T N
Y C T C M E S T Y P A E R M M
Y W B W S B C S I J Q M U M U
C A U Z K U R A Q C I U O V P
D I N O S A U R P W B L K M F
F X C G M P N F G S R B E V A



THAT'S ODD...

Circle the odd one out in each list

- 1 Mars, Venus, Saturn, Europa
- 2 Platypus, Dog, Cat, Squirrel
- 3 Humerus, Radius, Ulna, Bicep
- 4 Diplodocus, Triceratops, Allosaurus, Stegosaurus
- 5 Carbon, Silver, Gold, Copper

MATCH UP

Draw a line to join each baby animal to the correct adult

Calf

Elver

Nymph

Squab

Puggle

Leveret

Joey

Kitten

Cub

Kangaroo

Echidna

Cicada

Rabbit

Elephant

Pigeon

Hare

Tiger

Eel

ANSWERS

THAT'S ODD...

1. Europa - it's a moon, the others are planets. 2. Platypus - it lays eggs, the others give birth to live young. 3. Bicep - it's a muscle in your arm, the others are bones. 4. Allosaurus - it's a carnivore, the others are herbivores. 5. Carbon - it's not a metal, all the others are.

MATCH UP

Calf - Elephant, Elver - Eel, Nymph - Cicada, Squab - Pigeon, Puggle - Echidna, Leveret - Hare, Joey - Kangaroo, Kitten - Rabbit, Cub - Tiger



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How do chameleons change colour? p66

Why are paper cuts so painful? p67

If you hold in a fart, where does it go? p69

Why do sweaty feet smell of cheese? p70

Could my dog catch my cold? p73

Why does the inside of a shell sound like the sea? p74

Why don't slugs have shells? p75

Would a fight hurt less in microgravity? p77

Do insects sleep? p78

Why do leaves change colour in autumn? p79

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